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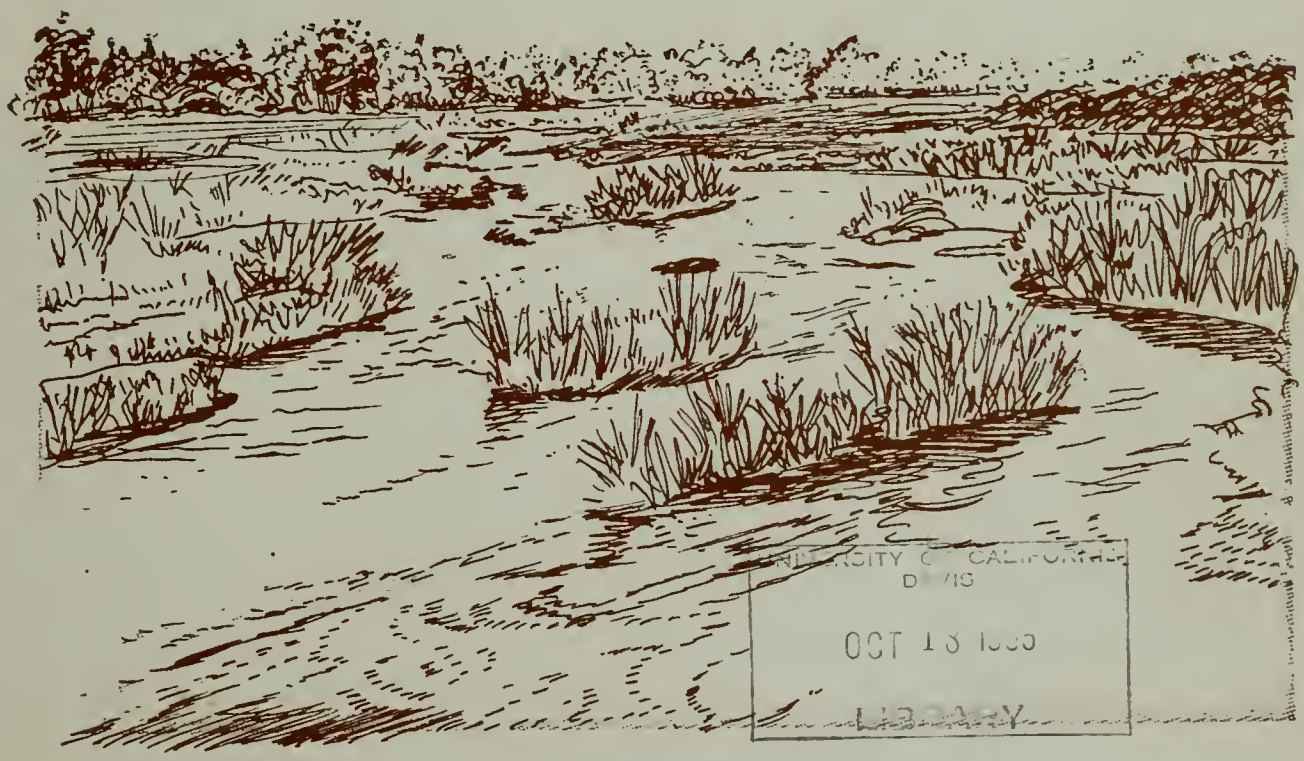
BULLETIN No. 71-64

UPPER SANTA ANA RIVER DRAINAGE AREA LAND AND WATER USE SURVEY, 1964



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UPPER SANTA ANA VALLEY FROM CORONA

Spence Air Photos

The Upper Santa Ana River Drainage Area has long been a leading agricultural area and, in recent years, it has also become a center of urban development.

State of California

THE RESOURCES AGENCY

Department of Water Resources

BULLETIN No. 71-64

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FOREWORD

In 1948, an intensive land and water use survey was conducted on a statewide basis. This information was published in State Water Resources Board Bulletin No. 2, "Water Utilization and Requirements of California", June 1955. The 1948 survey also served as the basis for a more detailed report on the entire Santa Ana River drainage area. This was published as Department of Water Resources' Bulletin No. 15, "Santa Ana River Investigation", February 1959.

To bring information on land and water use in the Upper Santa Ana River drainage area up to date, the Department began a new survey in 1957 and released Department of Water Resources' Bulletin No. 71, "Upper Santa Ana River Drainage Area Land and Water Use Survey, 1957", in May 1960. Bulletin No. 71-64, then, updates land and water use as presented in Bulletin No. 71.

Such updating of land and water use data has been carried on since 1957 for different areas throughout the Southern District as set forth in Sections 225, 226, and 232 of the California Water Code.

The Department of Water Resources expresses its thanks to the many farmers of the area without whose cooperation detailed crop mapping would not have been possible. The Department also wishes to thank the following public officials and agencies who contributed much of the data presented in this report: Riverside County Agricultural Commissioner; Riverside County Assessor; Riverside County Farm Advisor; Riverside County Planning Commission; San Bernardino County Agricultural Commissioner; San Bernardino County Assessor; San Bernardino County Farm Advisor;

San Bernardino County Planning Commission; and the United States Department of Agriculture, San Bernardino National Forest.

William E. Warne, Director
Department of Water Resources
The Resources Agency
State of California

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DEPARTMENT OF WATER RESOURCES

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cover illustration by

Robert L. Strawn . . . . . Delineator

AUTHORIZATION

The California Legislature of 1929 enacted legislation providing for investigations of the kind reported here, as follows:

> "Section 1. Out of any money in the state treasury not otherwise appropriated, the sum of four hundred fifty thousand dollars*, or so much thereof as may be necessary, is hereby appropriated to be expended by the State Department of Public Works in accordance with law in conducting work of exploration, investigation and preliminary plans in furtherance of a coordinated plan for the conservation, development and utilization of the water resources of California including the Santa Ana River and its tributaries, the Mojave River and its tributaries, and all other water resources of Southern California" (California Statutes of 1929, Chapter 832, Section 1).

Subsequent sessions of the Legislature have appropriated funds for continuing investigations of the water resources of Southern California in accordance with legislative intent expressed in the foregoing statute and in Sections 225 and 226 of the California Water Code, quoted as follows:

> "225. The department may carry on topographic surveys and investigations into matters pertaining to the water resources of the State along the lines of hydrography, hydro-economics, and the use and distribution of water for agricultural purposes, and to that end, where possible and to the best interest of the State, shall enter into contracts for cooperation with the different departments of the Federal Government. The department, with the consent of the Governor, may maintain and continue such surveys and investigations where there is available money not covered by cooperative contract.
>
> "226. The department, either independently or in cooperation with any person or any county, state, federal, or other agency, may do any of the following:
>
> (a) Conduct investigations of all or any portion of any stream, stream system, lake or other body of water.
>
> (b) Investigate either or both surface and underground water conditions.
>
> (c) Collect records of diversion and use of water.
>
> (d) Supervise distribution of water in accordance with agreements and court orders therefor.

---

*Reduced by the Governor to $390,000.

(e) Conduct investigations of the rate of use of water for various purposes and considering various soil conditions."

In 1956, the State Legislature further directed the Department of Water Resources to make continuing investigations to develop "information as to water which can be made available for exportation from the watersheds in which it originates without depriving those watersheds of water necessary for beneficial uses therein." This legislation specifically requested investigation of and reports on the following matters:

> "(a) The boundaries of the respective watersheds of the State and the quantities of water originating therein; (b) The quantities of water reasonably required for ultimate beneficial use in the respective watersheds; (c) The quantities of water, if any, available for export from the respective watersheds; (d) The areas which can be served by the water available for export from each watershed; and (e) The present uses of water within each watershed together with the apparent claim of water right attaching thereto, excluding individual uses of water involving diversions of small quantities which, in the judgment of the Director of Water Resources, are insufficient in the aggregate to materially affect the quantitative determinations included in the report."
> (California Statutes of 1956, First Extra Session, Chapter 61; Water Code Section 232).

Pursuant to the foregoing legislative directives, the Department of Water Resources began a program of continuing surveys of land and water use in the water-deficient Southern California area during 1957. Surveys are usually made each year somewhere in Southern California, so that land and water use are determined at periodic intervals for every area.

ABSTRACT

Bulletin No. 71-64 reports that, in the Upper Santa Ana River Drainage Area, urban development has been rapidly increasing and agricultural development has been decreasing. Land and water use trends and population growth patterns have led to an estimated water requirement of 1,263,000 acre-feet by the year 2020. / The area covers 2,260 square miles, including the coastal portions of Riverside and San Bernardino Counties and small portions of Los Angeles and Orange Counties. It consists of two hydrologic units: Santa Ana River and San Jacinto Valley. Population in the Riverside-San Bernardino areas increased from 548,000 in 1957 to 812,000 in 1964. In 1964, the population for the entire study area was estimated to be 880,000. The population growth was centered around the cities of Ontario, Riverside, and San Bernardino. / The area comprises three valleys (Upper Santa Ana, San Jacinto, and Elsinore), which are surrounded and separated by hills and mountains. / The principal economic activity is agriculture but industry is increasing. The net urban-suburban area increased from 61,800 acres in 1957 to 106,280 acres in 1964 with a subsequent increase in water use from 92,400 acre-feet in 1957 to 130,800 acre-feet in 1964. The net irrigated agricultural area decreased from 169,840 acres in 1957 to 161,640 acres in 1964. The net water use for agriculture decreased from 267,500 acre-feet in 1957 to 246,300 acre-feet in 1964. This is still almost twice the urban-suburban value. / Foldout plates depict hydrologic units, subunits, subareas; major water agencies; water-bearing sediments; present land use; and change in land use between 1957 and 1964.

CHAPTER I. INTRODUCTION AND SUMMARY

The uses that men make of the land and the amount of water that they require for carrying out those uses are ever changing. In most of Southern California, they are also ever increasing.

To be able to predict the water needs of an area and thus be able to plan ways of meeting those needs, the public and its water agencies must be able to recognize the changes taking place in use of the land.

One of the areas that has proved particularly important to the economy of Southern California is a relatively small area in the western portion of San Bernardino and Riverside Counties (and extends to a lesser extent into Los Angeles and Orange Counties) which is tributary to the Santa Ana and San Jacinto Rivers -- called the Upper Santa Ana River Drainage Area (Figure 1). It has long been a leading agricultural area and, in recent years, it has also become a center of urban development.

Charting the land uses and water needs in areas such as this began in 1947 when the California Legislature directed the Division of Water Resources and its predecessor agencies to conduct a comprehensive investigation of the water resources of the entire State. Out of this investigation came The California Water Plan -- a master blueprint for management of California's water resources.

Since then, the Department has periodically updated its land and water use surveys to keep abreast of the changes taking place. For example, the investigation reported here, which was conducted in late 1963 and early 1964, updates a similar survey made in 1956 and 1957 in the same area.

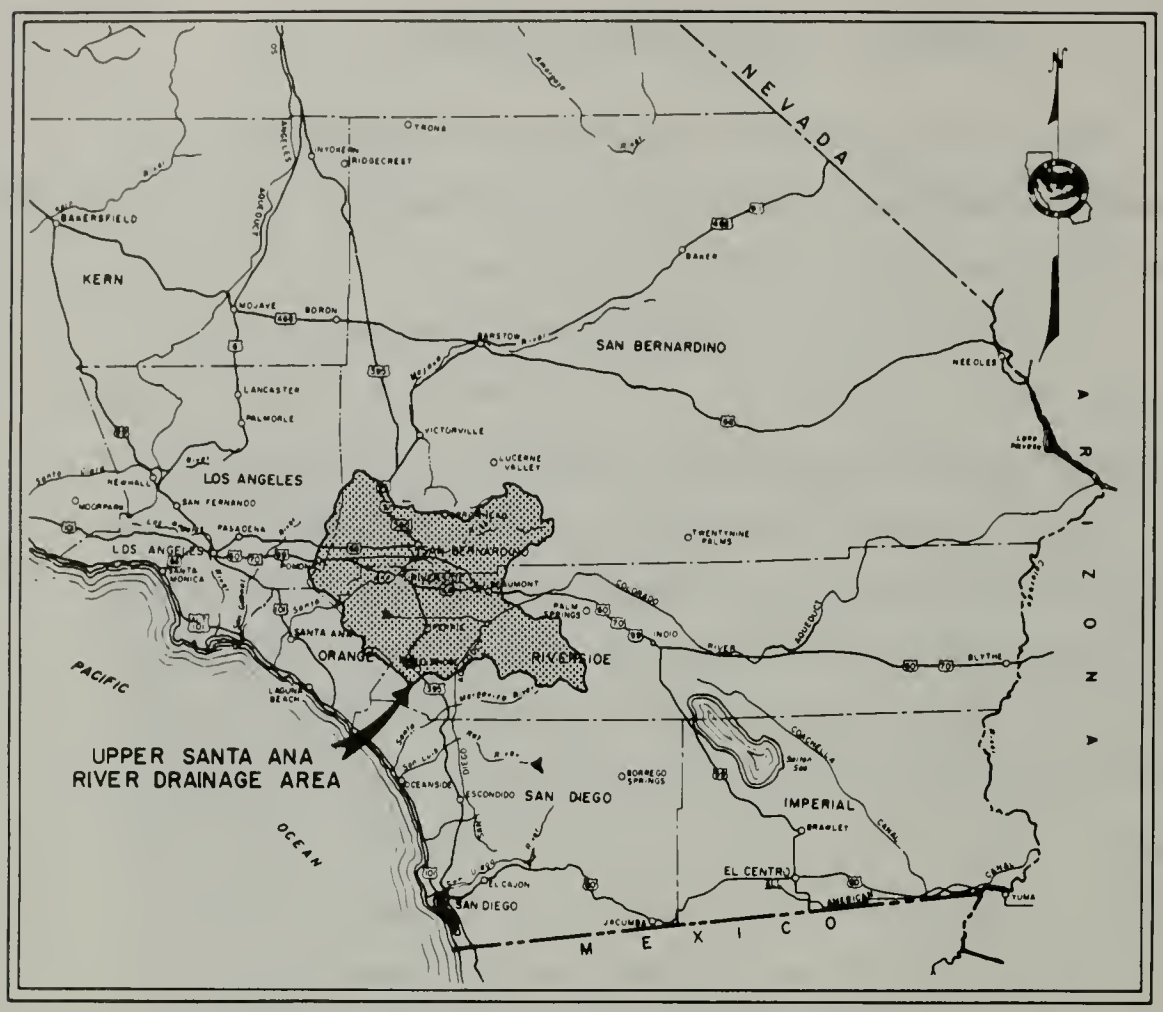


Figure 1. Location of Area of Investigation

Objectives and Conduct of Investigation

The objectives in making this survey were to: (1) develop information on present water use in the study area; (2) compare present water use with historical use to determine water use trends; and (3) compare present use with available information on local and imported water supplies to ascertain the need for supplemental water.

Mapping of land use in the Upper Santa Ana River Drainage Area was carried out by field crews who delineated the various land use types on recent aerial photographs. In the office, these field delineations were projected onto reproducible prints of United States Geological Survey quadrangle maps at a scale of 1:24,000. These maps served as area control maps insuring the accuracy of the succeeding process, while the reproducible prints served as masters for reproducing land use delineations on vellum prints. The individual areas of land use types were cut from the vellum prints and weighed, and these weights were converted into total acreages of individual land use types. These various land use types were grouped according to their water requirements. Then, appropriate unit values of water use were employed to estimate net water use.

Land use data collected by the Department of Water Resources are processed by machine techniques, which permit the evaluation of this data in terms of a sizable number of hydrologic, geographic, or political subdivisions with different boundaries. The tabulations in the main body of this report give land use within the boundaries that are thought to be the most generally useful. Land use tabulations for other areas are given in Appendix A.

For a critical hydrologic analysis, determining and compiling the types of land use -- both developed and undeveloped -- for the entire area of the hydrologic unit would be desirable. This would permit a comprehensive analysis and evaluation of the various levels of water use for the entire area. However, the additional expense incurred in making such a complete compilation is not felt to be warranted at present; therefore, only those areas that are underlain by water-bearing material are mapped

in their entirety. In those areas that are not underlain by water-bearing material, only types of land use requiring applied water are mapped. All other types of land use in areas not underlain by water-bearing material are tabulated in a category called "Unclassified".

Methods and procedures employed in this investigation are similar to those used in the 1957 survey. A detailed explanation of the classification of land use is given in Appendix B, and an explanation of the unit value method for estimating net water use is given in Appendix C. For definitions of terms as used in this report, see Appendix D. For a list of references used in this report, see Appendix E.

Summary of Findings

The investigation reported in this bulletin disclosed that in 1964 the land in the area of investigation was being put to the following uses:

Gross urban and suburban area	219,500 acres
Gross irrigated agriculture area	190,000 acres
Gross water service area	409,500 acres

During 1964, the estimated annual net water use in this water service area for urban and suburban lands was 130,300 acre-feet, and for irrigated agricultural lands was 246,300 acre-feet.

The following findings were made in the 1964 survey:

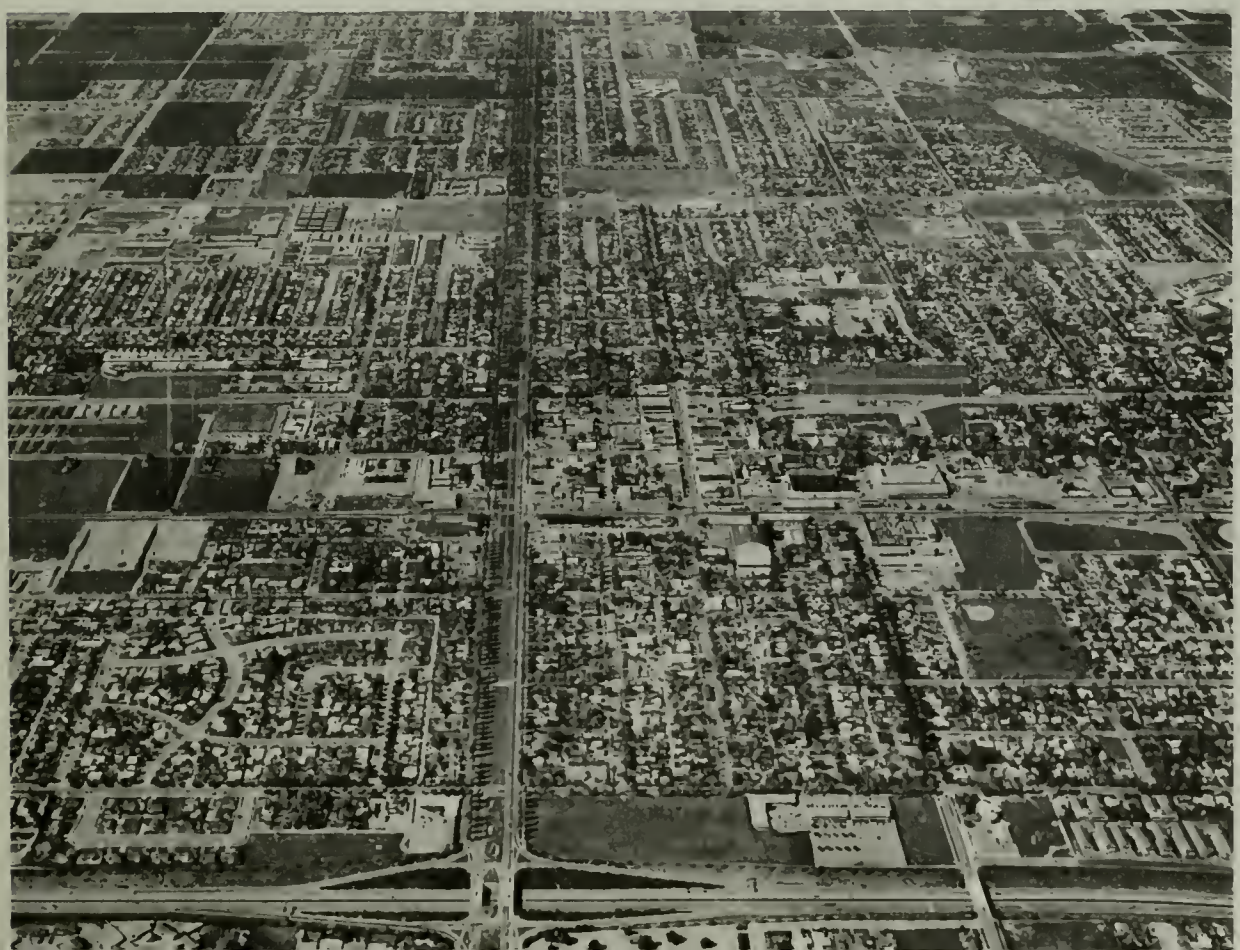
1. The combined population of the portions of Riverside and San Bernardino Counties that are within the study area has increased 48 percent since the 1957 survey (548,000 in 1957 to 812,000 in 1964).

1957

CHANGES IN LAND USE, UPLAND

Spence Air Photos

The population has shown a steady increase.



1965

Total population of the study area (including small parts of Los Angeles and Orange Counties) was 880,000 in 1964.

2. The net urban and suburban area increased from 61,880 acres in 1957 to 106,280 acres in 1964, an increase of 44,400 acres, or 72 percent.

3. The net irrigated agricultural area decreased from 169,840 acres in 1957 to 161,640 acres in 1964, a reduction of 8,200 acres, or about 5 percent.

4. The net water service area increased from 231,720 acres in 1957 to 267,920 acres in 1964, an increase of 36,200 acres, or about 16 percent.

5. Major water agencies encompass 54 percent of the study area and provide service to 94 percent of the water service area.

6. Annual net water use for urban and suburban acreage increased from 92,400 acre-feet to 130,800 acre-feet between 1957 and 1964, an increase of 38,400 acre-feet, or almost 42 percent.

7. Annual net water use on irrigated agricultural lands declined from 267,500 acre-feet to 246,300 acre-feet between 1957 and 1964, a decrease of 21,200 acre-feet. Even with an 8 percent decrease, the present value is still almost twice the urban and suburban water use.

8. Overall net water use increased about 17,200 acre-feet or almost 5 percent, from 359,900 acre-feet in 1957 to 377,100 acre-feet in 1964.

9. The deliveries of water imported to the Upper Santa Ana River Drainage Area from the Colorado River increased from 45,000 acre-feet in 1957 to 100,400 acre-feet in 1964.

10. The member agencies of The Metropolitan Water District of Southern California and the San Bernardino Valley Municipal Water District will import an estimated 376,800 acre-feet of water from the Colorado River and State Water Project by the year 1990.

11. The estimated total seasonal net water use for the Upper Santa Ana River Drainage Area by the year 2020 has been estimated to be 1,263,000 acre-feet. This means that nearly one million acre-feet of water will have to be imported to this area in the future.

Conclusions

Based on the results of this investigation, it is concluded that:

1. The population within the study area has shown a steady increase which will continue in the foreseeable future.

2. Urban and suburban growth has increased throughout the study area, particularly in Riverside, San Bernardino, and Ontario.

3. Irrigated agricultural lands will continue to lose choice acreage to urban and suburban expansion, but a portion of this loss will be offset by new development of lands which previously have been in native vegetation or farmed under a nonirrigated condition.

4. Present water supply, both local and imported, relieves but does not solve the current overdraft condition. Increasing amounts of imported water will be needed as the area continues to grow.

5. The Upper Santa Ana River Drainage Area is undergoing very rapid changes. Acceleration of these changes will require continued periodic inventories of land use to serve as a foundation for future water resources planning and development.

EXPANSION OF ONTARIO TOWARD SAN BERNARDINO

Spence Air Photos

Irrigated agricultural lands will continue to lose choice acreage to urban and suburban expansion.

CHAPTER II. AREA OF INVESTIGATION

This chapter locates and describes the area of investigation, details the two hydrologic units that form it, discusses the population trends within it, and outlines the sources of the water supply.

Location and Description

The area of investigation -- the Upper Santa Ana River Drainage Area -- is that part of the drainage area of the Santa Ana River above Prado Dam. It includes large portions of San Bernardino and Riverside Counties and smaller sections of Orange and Los Angeles Counties. The general location of the area of investigation -- the Upper Santa Ana River Drainage Area -- is shown on Figure 1, and the boundaries of the area are shown in detail on Plate 1.

The Upper Santa Ana River Drainage Area is situated on the Pacific slope of Southern California between the drainage areas of the San Gabriel and Santa Margarita Rivers. This study area covers a total of about 2,260 square miles. It is roughly rectangular in shape with a north-south width averaging about 45 miles and an east-west length averaging about 50 miles.

The area is composed of the Upper Santa Ana, San Jacinto, and Elsinore Valleys, which are surrounded and separated by hills and mountains. The northern and eastern boundaries are formed by the rugged San Gabriel, San Bernardino, and San Jacinto Mountains, which attain elevations in excess of 10,000 feet, while the western boundary is formed by the Chino Hills. The Santa Ana Mountains and a relatively low-lying series of

rolling hills and drainage divides provide the southern boundary of the area and separate it from the adjacent watersheds of the Santa Margarita River and other coastal streams.

The Santa Ana River is the principal stream draining the area. It rises in the San Bernardino Mountains and flows southwesterly across the Upper Santa Ana Valley to the Santa Ana Canyon below Prado Dam. From here it crosses the coastal plain of Orange County and discharges to the Pacific Ocean between Huntington Beach and Newport Beach.

South and east of this, the San Jacinto River is the principal stream draining the San Jacinto Valley. This stream has its beginning southeast of San Jacinto and is joined by such tributaries as Bautista, Indian, Poppet, and Potrero Creeks. It flows northwesterly and eventually bends to the southwest, finally leaving the San Jacinto Valley through Railroad Canyon whence it discharges into Elsinore Valley and Lake Elsinore. Lake Elsinore, when full, overflows into Temescal Wash, which joins the Santa Ana River near Prado Dam. Discharge from Lake Elsinore has not occurred since the 1916-17 season.

In general, the Upper Santa Ana River Drainage Area enjoys an equable climate with warm, dry summers and mild winters. Both temperature and precipitation vary considerably with distance from the ocean, elevation, and topography. At Riverside, about 38 miles from the ocean and 900 feet above sea level, the seasonal temperature has varied between extremes of 21° F. and 118° F. The average is about 63° F. The mean temperature at Squirrel Inn, near the origin of East Twin Creek, situated at an elevation of 5,700 feet in the San Bernardino Mountains, is 52° F., and extremes of 7° F. below zero and 99° F. have been recorded.

LAKE MATHEWS

Courtesy of The Metropolitan Water District

Lake Mathews is the terminal storage point for Colorado River water.

Precipitation characteristically occurs in the form of rain, although a portion falls in the higher mountains as snow. In general, the quantity of precipitation increases with elevation. The mean seasonal rainfall recorded at the San Bernardino County Hospital Station, in the city of San Bernardino, for the 30-year period 1930-31 through 1959-60, was 17.71 inches. Squirrel Inn has a mean seasonal rainfall of 42.19 inches for the period 1897-98 through 1946-47, with a recorded maximum rainfall of 77.61 inches during the 1915-16 season and a minimum recorded rainfall of 16.39 inches during the 1927-28 season.

Hydrologic Units

For this investigation, the Upper Santa Ana River Drainage Area was divided into two hydrologic units, Santa Ana River Hydrologic Unit, and San Jacinto Valley Hydrologic Unit. Based on geological considerations related to the occurrence of ground water, the Santa Ana River Unit was further subdivided into the Middle Santa Ana River, Upper Santa Ana River, San Timoteo, Lake Mathews, San Bernardino Mountain, and Colton-Rialto Hydrologic Subunits; and the San Jacinto Valley Unit was subdivided into the Elsinore, Perris, and San Jacinto Hydrologic Subunits. These hydrologic units and subunits, along with finer subdivisions called subareas, are shown on Plate 1. The areas of the units are presented in Table 1.

Santa Ana River Unit

The portion of the Santa Ana River Hydrologic Unit within the study area includes about 1,495 square miles of both mountainous and valley land, or about 66 percent of the total study area. The northern

and eastern boundaries are formed by the San Gabriel and San Bernardino Mountain ranges. These ranges rise steeply from the valley floor with some peaks attaining heights in excess of 10,000 feet. The Santa Ana Mountains, which are less precipitous and lower in elevation, form the southern boundary of the portion of the unit within the study area. The Chino and Puente Hills lie on the western edge of the valley area. The remaining portion of this unit, which does not lie within the study area, extends southwesterly to the Pacific Ocean and includes the major part of Orange County.

TABLE 1

AREAS OF HYDROLOGIC UNITS AND
SUBUNITS IN UPPER SANTA ANA RIVER DRAINAGE AREA

Unit and Subunit	Acres
Santa Ana River Unit	
1. Middle Santa Ana River Subunit	362,920
2. Upper Santa Ana River Subunit	231,580
3. San Timoteo Subunit	79,110
4. Lake Mathews Subunit	102,910
5. San Bernardino Mountain Subunit	116,920
6. Colton-Rialto Subunit	63,130
Subtotal	956,570
San Jacinto Valley Unit	
7. Elsinore Subunit	31,560
8. Perris Subunit	221,360
9. San Jacinto Subunit	237,020
Subtotal	489,940
TOTAL	1,446,510

The topography of the valley lands is generally smooth and regular, but hills distributed throughout break the surface regularities to varying degrees. The principal soil families recognized in the Santa Ana River Unit are recent alluvial, old valley fill, and residual soils. The Santa Ana River is the principal river in this unit. Some of the more important streams are Lytle, Deer, Day, Cucamonga, San Antonio, Chino, and San Timoteo Creeks. Most of the water that flows in the Santa Ana River percolates to recharge vast underground storage basins.

Prado Flood Control Dam is located at the upper end of Santa Ana Canyon. This dam has a capacity of 223,000 acre-feet, and permits flows through Santa Ana Canyon during all seasons of the year.

Lake Mathews, terminal storage point for the Colorado River Aqueduct, is the largest reservoir in the unit. It is owned and operated by The Metropolitan Water District of Southern California, and has a storage capacity of 182,000 acre-feet.

Extensive recreational facilities are located throughout the Big Bear Lake area about 35 miles from the City of Redlands. During the winter months this area is used primarily for skiing and other winter sports while in the summer many persons enjoy camping, hiking, and fishing.

San Jacinto Valley Unit

The San Jacinto Valley Hydrologic Unit, which lies southeast of the Santa Ana River Unit, covers an area of about 765 square miles. It is bounded on the north by the San Timoteo Badlands and on the east by the San Jacinto Mountains. The southern and western boundaries are not quite so visibly defined, but follow the drainage divide along gently to steeply rolling hills south of Hemet to the ridge of the Santa Ana

Mountains, and then turn northeast and north to run along the hills west of Perris. The San Jacinto River is the principal stream draining the unit.

The San Jacinto Valley soils generally have moderately to well developed profiles with restricted internal drainage, or else overlie relatively impervious substrata. Soils within the Elsinore Valley are generally poor. Therefore, agriculture has been limited to terrace soils bordering the basin, with lowlands used for pasturage.

The three most important reservoirs in the unit are Hemet, San Jacinto, and Railroad Canyon Reservoirs. Perris Reservoir, the planned southern terminal storage facility of the State Water Project, will be constructed about 5 miles northeast of Perris.

Lake Elsinore is the most notable geographic feature within the Elsinore Valley. The lake became dry in 1951 after years of extended drought; however, in February 1964, 30,000 acre-feet of surplus water from the Colorado River were purchased from the Metropolitan Water District and put into the lake for recreational purposes.

Population

The population of the Upper Santa Ana River Drainage Area grew at a more or less constant rate from the middle of the 19th century until almost the middle of the 20th (1940), accompanying the agricultural expansion of the area. The war years, 1941 through 1945, brought a large number of military personnel and increased the demand for both agricultural and industrial workers. After the war, many who had migrated to the area remained because of the equable climate. As elsewhere in Southern California, this growth has continued during the postwar years.

At the time of the 1960 census, the combined population of Riverside and San Bernardino Counties within the area of investigation was about 636,000, a 67 percent increase over the 1950 census figure. The population within the study area of these two counties was estimated to be 548,000 in 1957 and 812,000 in 1964, an increase of about 48 percent.

Within the entire study area the 1964 population was estimated to be 880,000. In 1964, most of the population resided in the Santa Ana River Unit, generally concentrated in the metropolitan areas of Pomona, Riverside, San Bernardino, and Ontario. Estimates prepared by the Department indicate that by the year 2020 the population within the study area will exceed 4,700,000.

Urban and Suburban Development

The Upper Santa Ana River Drainage Area at present has more land devoted to agriculture than to urban-suburban purposes. However, continued population growth suggests that a gradual change from a mixed urban and agricultural land use pattern to a primarily urban development is taking place. This transformation has been most apparent around the cities of San Bernardino, Riverside, Ontario, and Pomona.

These cities are strategically located near the large commercial and industrial complexes of Los Angeles and Orange Counties. The population "spillover" from the urban expansion in those two counties in the past decade has been the major factor in urban growth.

Industrial development in the Upper Santa Ana River Drainage Area, which has taken place mainly since the mid-fifties, has been of very modest proportions. Prior to World War II, the economy was primarily oriented around agriculture and allied industries.

CEMENT PLANT NEAR COLTON Spence Air Photos

Today, while agricultural activities are still important, they have been supplemented by a sharply expanded and diversified industrial complex.

Today, while agricultural activities are still important, they have been supplemented by a sharply expanded and diversified industrial complex. Some of the larger industries include the Kaiser Steel facilities (near Fontana), the Santa Fe Railway repair shops, the California Portland Cement plant, and numerous smaller manufacturing establishments in the vicinity of San Bernardino, Riverside, and Colton. Commerical development has kept pace with related urban development.

The assessed valuation of all Riverside County increased from $534,311,620 in 1960 to $602, 911,000 in 1964 for an increase of 13 percent. The assessed valuation of all San Bernardino County increased from $671,952,440 in 1960 to $736,090,000 in 1964 for an increase of 10 percent. The City of Ontairo was valued for tax purposes at $48,037,880 in 1957, and $67,507,300 in 1964, an increase of about 41 percent. The City of Riverside for tax purposes increased during the same period from $119,729,790 to $174,755,660, or slightly less than 46 percent, while the City of San Bernardino increased from $103,451,020 to $153,062,690, or about 48 percent.

The growth of urban-suburban land use in the Upper Santa Ana River Drainage Area, based on surveys made in 1912, 1926, 1932, 1942, 1948, 1957, as well as the survey of 1964, is indicated on Figure 2.

Agricultural Development

The first known agricultural development in the Upper Santa Ana River Drainage Area occurred as early as 1810 in the vicinity of the convergence of Lytle Creek and Warm Creek. However, not until the latter half of the 19th century did significant expansion of irrigated lands

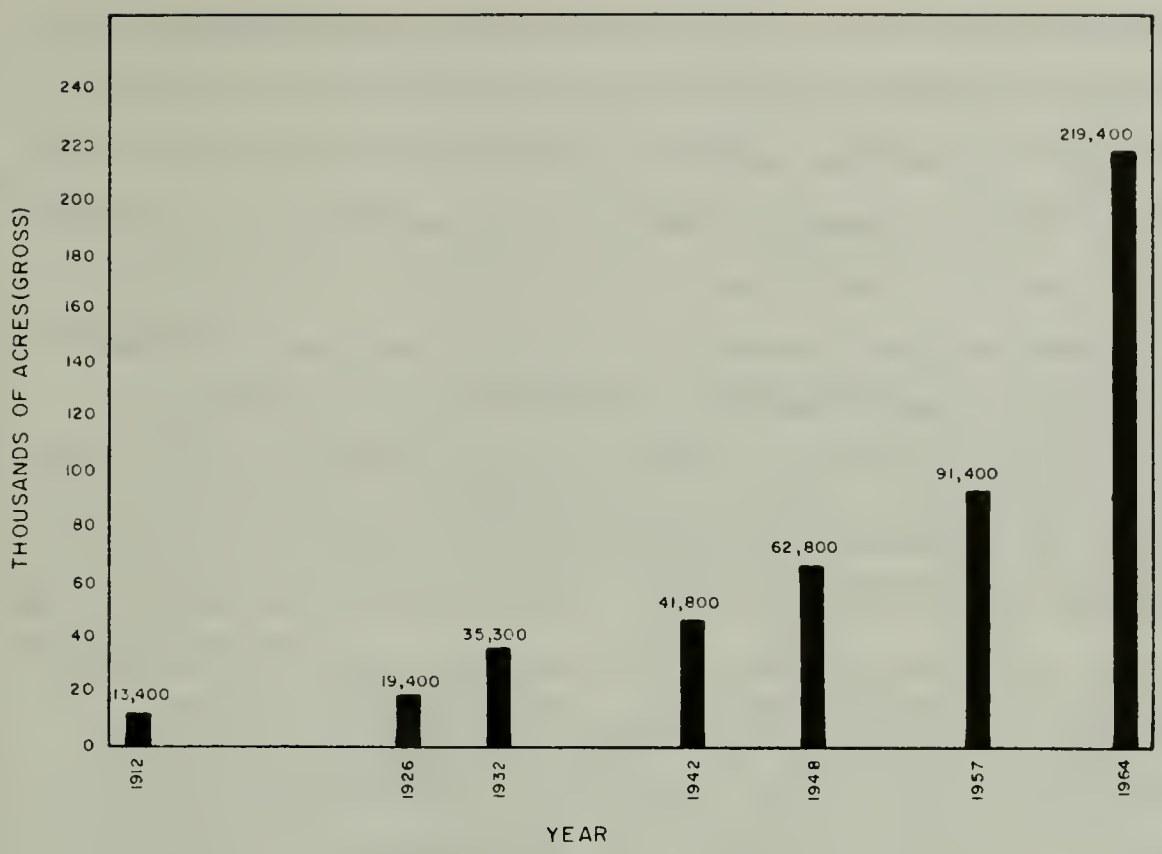


Figure 2. Historical Urban and Suburban Land Use of the Upper Santa Ana River Drainage Area

begin. According to William Hammond Hall, in "Report of the State Engineer to the Legislature of the State of California -- Session of 1880", irrigated crops during that period included vineyards, orchards of semitropical and deciduous fruits, corn, potatoes, alfalfa, and truck gardens. The most important single development of this era was the establishment of the citrus industry in the Riverside area about 1870. Shipments of citrus fruit to eastern points began during the 1880's. Commencing about 1900, the planting of orchards, primarily citrus, became common.

The greatest influence on expansion of agricultural development was the introduction of the deep-well turbine pump. With this type of

equipment, ground water pumping on a large scale began, bringing about an increase of approximately 410 percent in agricultural acreage between 1888 and 1926. In 1948 a net area of more than 183,000 acres was devoted to irrigated agriculture in the study area. The principal crops included citrus, vineyards, truck crops, alfalfa, and pasture. A comparison of this acreage with that obtained in the 1957 land use survey shows that approximately 7 percent less net acreage was devoted to agriculture in 1957 -- primarily as a result of urban encroachment on agricultural lands. By 1964, net cropped irrigated agricultural lands totaled 161,640 acres, which was a further decline of about 5 percent from the 1957 acreage. This has been due to economic competition between agricultural land and urban development. For example, San Bernardino County recently lost almost 1,000 acres of citrus to urban encroachment. To compensate for some of this loss, new acreage is being brought under cultivation on land which previously had been dry farmed or was in native vegetation.

Although agricultural acreage in the Upper Santa Ana River Drainage Area has shown some decrease, the total estimated value of farm commodities has increased since the 1957 survey. The total gross agricultural income to the area was $262,685,000 in 1964. The breakdown of this income by county is as follows: Riverside, $145,052,000; San Bernardino, $116,941,000; and Los Angeles, $692,000. Therefore, although agriculture is declining in acreage, it is still a major source of income.

Water Supply

Historically, water supplies for the urban and agricultural developments in the Upper Santa Ana River Drainage Area have been derived

from ground water pumping and, to a limited extent, from storage or diversion of surface runoff. In recent years, increasing amounts of water imported through the Colorado River Aqueduct have been utilized. Water from the State Water Project will be delivered beginning in 1972.

Ground Water

A factor of great importance in the development of the Upper Santa Ana River Drainage Area is the existence of large ground water resources underlying most of the valley areas. Water extracted from these basins has provided much of the water supply for extensive urban and agricultural development.

The water-bearing deposits of the Upper Santa Ana River Drainage Area are comprised primarily of alluvial gravel, sand, and clay sediments of late Tertiary and Quaternary age. These deposits have been subjected to extensive faulting, creating barriers to ground water movement and serving to subdivide the area underlying the valleys into a number of separate ground water basins. Although areas of confined ground water occur, they are not extensive. The water-bearing deposits are replenished primarily by deep penetration of rainfall on the valley floor and deep percolation of runoff from the surrounding mountains. Because a large part of the water-bearing deposits and the deposits above the water table are relatively coarse-grained, their recharge potential and storage capacity are ample to permit a relatively high degree of conservation and regulation of local ground water supplies. Water-bearing sediments are shown on Plate 1.

Ground water movement generally follows the slope of the surface terrain. In the Santa Ana River Unit, this movement is southwesterly toward

Prado Dam where the water rises in the bed of the Santa Ana River and flows through Santa Ana Canyon into Orange County.

Surface Water

The first recorded use of local water supplies was that made by the mission fathers, who diverted the flow of the Santa Ana River in Santa Ana Canyon downstream from the study area, as early as 1810. By 1850, facilities had been developed for additional diversions from the Santa Ana River in Santa Ana Canyon and below the present City of Colton and from San Antonio Creek.

Mormons from Salt Lake City settled in the Santa Ana River Basin in the early 1850's, founded the City of San Bernardino, and acquired the rights to the flow of Mill Creek formerly owned by the mission fathers. The settlers also diverted water for irrigation from the Santa Ana River north of the present location of Redlands, and from Lytle Creek to the west of what is now the City of San Bernardino. During this period, surface flow was developed to provide water power to operate saw and flour mills.

During the 1880's, several larger water supply developments were constructed to provide for rapidly increasing citrus production. Big Bear Dam was constructed at this time, in addition to a number of canals, including the Gage and the Riverside Canals located on Warm Creek and the Santa Ana River, respectively. These canals diverted surface stream flow, supplemented by ground water primarily from flowing wells in the Bunker Hill area, and conveyed the waters to service areas in the vicinity of the Cities of Riverside, San Bernardino, Redlands, and Rialto.

The total water supply (both surface and underground) that is available to the entire study area year after year without causing detrimental effects to ground water elevations is termed safe yield. This value is very difficult to derive, but it has been estimated to be about 266,000 acre-feet in the study area for the base period 1883-84 through 1944-45 and supplemented by information gathered from 1945-46 through 1947-48. This value was determined from studies made in connection with State Water Resources Board Bulletin No. 2, Department of Water Resources Bulletin No. 15, and State Division of Water Resources Bulletin No. 53.

Imported Water

Water is imported to the Upper Santa Ana River Drainage Area from the Colorado River through facilities of The Metropolitan Water District of Southern California. Construction of the facilities commenced in 1933, and imported water in small quantities was first delivered to military bases in the area in 1943. Since 1950 the annual imports have increased rapidly to 45,100 acre-feet in 1956-57 and 100,400 acre-feet in 1963-64. Data presented in Table 2 indicate the quantities of imported water delivered to the area in 1963-64. The boundaries of the agencies listed in this table are shown on Plate 2.

While deliveries of imported water to the study area increased 55,400 acre-feet between 1957 and 1964, net water use was estimated to have increased almost 17,200 acre-feet over the same period. Thus, the increase in the volume of water imported from the Colorado River into the Santa Ana River Unit above Prado Dam exceeded the increase in net water use but still left an overdraft condition of some 10,700 acre-feet.

TABLE 2

ESTIMATED DELIVERIES OF COLORADO RIVER WATER
TO AGENCIES IN THE UPPER SANTA ANA RIVER
DRAINAGE AREA IN 1963-64

Unit	Acre-feet
Santa Ana River Unit	
Chino Basin M.W.D.*	16,300
Western M.W.D.*	46,300
Pomona Valley M.W.D.*	1,700
Subtotal	64,300
San Jacinto Valley Unit	
Camp Haan**	1,600
Eastern M.W.D.*	34,500
Subtotal	36,100
TOTAL	100,400

*Municipal Water District
**Within March Air Force Base

The State Water Project provides for a vast system of dams, aqueducts, and pumping plants to deliver water from Northern California to Southern California. The system is now in the construction stage, and by 1972 will be delivering water to Southern California and the Upper Santa Ana River Drainage Area.

The Metropolitan Water District of Southern California has contracted for 2,011,500 acre-feet of State Project water; a portion of this water will be used in the study area. The San Bernardino Valley Municipal Water District, which is not a member of The Metropolitan Water District of Southern California, has also contracted for 98,000 acre-feet of State

Project water. The San Gorgonio Pass Water Agency has contracted for a maximum entitlement of 17,300 acre-feet of State Project water. The Big Bear Municipal Water District is negotiating a contract with the State for a maximum entitlement of 4,600 acre-feet of State Project water.

Sewage and Industrial Waste Water

Effluent discharges from nearly all sewage treatment plants in the Upper Santa Ana River Drainage Area are released to settling basins and stream channels. Some of the treated effluent is used for irrigation purposes. Percolation of this effluent along with that from privately owned cesspools and septic tanks constitutes an important source of replenishment to the underlying ground water basins.

At present, the volume of sewage exported from the area is limited to a small amount conveyed from the vicinity of the City of Pomona to the San Gabriel Valley through the Los Angeles County Sanitation District No. 21 trunkline and from the Pomona Water Reclamation Plant. This flow is estimated to be 9,500 acre-feet per year.

CITY OF SAN BERNARDINO

Pacific Air Industries' Photo

Urban and suburban growth has increased throughout the study area, particularly in Riverside, San Bernardino, and Ontario.

CHAPTER III. LAND USE

The nature, location, and extent of land use within the Upper Santa Ana River Drainage Area were determined by a detailed survey conducted during late 1963 and early 1964. For brevity, this investigation has throughout the text been called the 1964 land use survey. The results of that survey are presented in this chapter. Comparisons of land use found during the present survey and during previous surveys are also presented.

For analysis and presentation, the various land uses were classified and grouped according to their water requirements. A detailed explanation of land use classification used in this report is presented in Appendix B. The classes of land use described in Appendix B are similar to those used in Bulletin No. 71 (reporting on the 1957 survey), except that "weekend" residences, summer home tracts, and campgrounds within a primarily recreational area, previously included in "Residential", are here classified as "Recreational-residential". Irrigated fallow and idle lands were formerly placed in the "Nonirrigated agriculture category", but for this bulletin these lands have been considered part of the gross irrigated area.

Results of Land Use Survey

Data derived from the 1964 land use survey are compiled in Table 3 by hydrologic units and subunits, and in Table 4 by counties. In Appendix A further detailed breakdowns of these data are presented according to the hydrologic subareas as delineated on Plate 1. The subtotals in all of the tables are in terms of net acreage (i.e., minus the streets, rights-of-way, and other nonwater-using sections within the particular land uses).

TABLE 3

LAND USE IN HYDROLOGIC UNITS AND SUBUNITS OF THE

IN ACRES

LINE NO.	CATEGORY AND CLASS OF LAND USE	SAN JACINTO VALLEY HYDROLOGIC UNIT				
		STUDY AREA	ELSINORE SUBUNIT	PERRIS SUBUNIT	SAN JACINTO SUBUNIT	UNIT TOTAL
	WATER SERVICE AREA					
	URBAN AND SUBURBAN					
1	Residential	67,850	1,360	5,590	2,070	9,020
2	Recreational Residential	6,330	0	10	1,510	1,520
3	Commercial	11,450	170	790	590	1,550
4	Industrial	2,390	**	170	20	190
5	Unsegregated Urban and Suburban	18,260	180	3,130	1,250	4,560
6	Subtotals	106,280	1,710	9,690	5,440	16,840
7	Included Nonwater Service Area	113,220	1,290	13,750	2,650	17,690
8	Gross Urban and Suburban Area	219,500	3,000	23,440	8,090	34,530
	IRRIGATED AGRICULTURE					
9	Alfalfa	17,240	30	7,200	1,400	8,630
10	Pasture	16,210	60	1,330	1,740	3,130
11	Citrus and Subtropical	51,350	430	1,780	1,810	4,020
12	Truck Crops	19,010	40	8,950	440	9,430
13	Field Crops	6,570	0	700	0	700
14	Deciduous Fruits and Nuts	5,410	660	850	1,930	3,440
15	Small Grain	21,710	70	17,370	2,270	19,710
16	Vineyards	24,140	0	0	0	0
17	Subtotals	161,640	1,290	38,180	9,590	49,060
18	Fallow	9,230	60	6,360	760	7,180
19	Included Nonwater Service Area	19,130	90	4,570	1,420	6,080
20	Gross Irrigated Agriculture	190,000	1,440	49,110	11,770	62,320
21	Gross Water Service Area	409,500	4,440	72,550	19,860	96,850
	NONWATER SERVICE AREA					
22	NONIRRIGATED AGRICULTURE	78,150	1,240	43,950	11,240	56,430
23	NATIVE VEGETATION	248,700	7,810	27,890	64,900	100,600
24	UNCLASSIFIED	710,160	18,070	76,970	141,020	236,060
25	Gross Nonwater Service Area	1,037,010	27,120	148,810	217,160	393,090
26	Totals	1,446,510	31,560	221,360	237,020	489,940

* Portion Within Study Area

UPPER SANTA ANA RIVER DRAINAGE AREA, 1964

SANTA ANA RIVER HYDROLOGIC UNIT *							LINE NO.
MIDDLE SANTA ANA RIVER SUBUNIT	UPPER SANTA ANA RIVER SUBUNIT	SAN TIMOTEO SUBUNIT	LAKE MATHEWS SUBUNIT	SAN BERNARDINO MOUNTAIN SUBUNIT	COLTON RIALTO SUBUNIT	UNIT TOTAL	
33,660	16,000	4,750	1,010	470	2,940	58,830	1
80	1,020	160	10	3,410	130	4,810	2
5,620	2,840	330	40	520	550	9,900	3
1,550	470	**	90	20	70	2,200	4
9,110	2,080	1,440	340	190	540	13,700	5
50,020	22,410	6,680	1,490	4,610	4,230	89,440	6
64,070	15,490	3,570	3,890	1,370	7,140	95,530	7
114,090	37,900	10,250	5,380	5,980	11,370	184,970	8
7,780	330	360	40	0	100	8,610	9
11,770	730	550	0	10	20	13,080	10
27,130	14,580	610	4,230	0	780	47,330	11
9,340	70	10	40	0	120	9,580	12
5,770	90	0	0	0	10	5,870	13
450	100	1,350	20	10	40	1,970	14
840	880	270	10	0	0	2,000	15
22,960	560	0	0	0	620	24,140	16
86,040	17,340	3,150	4,340	20	1,690	112,580	17
1,640	220	90	0	0	100	2,050	18
10,500	1,290	500	520	**	240	13,050	19
98,180	18,850	3,740	4,860	20	2,030	127,680	20
212,270	56,750	13,990	10,240	6,000	13,400	312,650	21
8,310	950	10,160	1,450	0	850	21,720	22
41,040	41,410	32,860	13,460	4,910	14,420	148,100	23
101,300	132,470	22,100	77,760	106,010	34,460	474,100	24
150,650	174,830	65,120	92,670	110,920	49,730	643,920	25
362,920	231,580	79,110	102,910	116,920	63,130	956,570	26

** Less Than Five Acres

At the time of the survey, the gross acreage requiring water service within the area of investigation was about 409,500 acres. Of this, 190,000 acres, or about 46 percent, were devoted to irrigated agriculture, while urban-suburban development amounted to 219,500 acres. About 312,650 acres, or nearly 76 percent, of lands requiring water service in the area in 1964 were in the Santa Ana River Unit. Approximately two-thirds of this acreage was in the Middle Santa Ana River Subunit.

Detailed information concerning the pattern of land use as determined from this survey is presented on Plates 3A, 3B, and 3C. Although the acreages of nonwater service areas within urban-suburban and irrigated agricultural categories are shown individually on Table A-1 in Appendix A, they were not differentiated on the plates. Also omitted from the plates were developed nonwater service lands, such as nonirrigated agriculture, and undeveloped nonwater service lands, such as native vegetation.

A tabulation of 1964 land use within major water service agencies in the Upper Santa Ana River Drainage Area is presented in Table 5. The boundaries of the agencies are shown in detail on Plate 2. About 790,490 acres, 54 percent of the study area, lie within these six major water service districts, but these districts serve 94 percent (383,320 acres) of the gross water service area (409,500 acres) within the study area. Approximately 198,200 acres of the gross water service area within these districts are devoted to urban-suburban use, and 185,120 acres to irrigated agriculture.

TABLE 4

LAND USE BY COUNTIES IN THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964

IN ACRES

CATEGORY AND CLASS OF LAND USE	ORANGE	LOS ANGELES	RIVERSIDE	SAN BERNARDINO	TOTAL
WATER SERVICE AREA					
URBAN AND SUBURBAN					
RESIDENTIAL	0	3,440	27,270	37,140	67,850
RECREATIONAL RESIDENTIAL	0	10	1,550	4,770	6,330
COMMERCIAL	0	890	3,920	6,640	11,450
INDUSTRIAL	0	180	760	1,450	2,390
UNSEGREGATED URBAN AND SUBURBAN	0	400	8,860	9,000	18,260
SUBTOTALS	0	4,920	42,360	59,000	106,280
INCLUDED NONWATER SERVICE AREA	0	3,510	48,840	60,870	113,220
GROSS URBAN AND SUBURBAN AREA	0	8,430	91,200	119,870	219,500
IRRIGATED AGRICULTURE					
ALFALFA	0	170	12,420	4,650	17,240
PASTURE	0	10	9,200	7,000	16,210
CITRUS AND SUBTROPICAL	0	670	24,990	25,690	51,350
TRUCK CROPS	0	100	13,570	5,340	19,010
FIELD CROPS	0	0	2,900	3,670	6,570
DECIDUOUS FRUITS AND NUTS	0	0	4,130	1,280	5,410
SMALL GRAIN	0	330	20,020	1,360	21,710
VINEYARDS	0	0	1,620	22,520	24,140
SUBTOTALS	0	1,280	88,850	71,510	161,640
FALLOW	0	0	8,170	1,060	9,230
INCLUDED NONWATER SERVICE AREA	0	110	10,380	8,640	19,130
GROSS IRRIGATED AGRICULTURE	0	1,390	107,400	81,210	190,000
GROSS WATER SERVICE AREA	0	9,820	198,600	201,080	409,500
NONWATER SERVICE AREA					
NONIRRIGATED AGRICULTURE	0	30	71,520	6,600	78,150
NATIVE VEGETATION	0	1,260	150,060	97,380	248,700
UNCLASSIFIED	1,360	7,890	370,290	330,620	710,160
GROSS NONWATER SERVICE AREA	1,360	9,180	591,870	434,600	1,037,010
TOTALS	1,360	19,000	790,470	635,680	1,446,510

TABLE 5

LAND USE IN SERVICE AREAS OF MAJOR WATER AGENCIES OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964

IN ACRES

CATEGORY AND CLASS OF LAND USE	MEMBER AGENCIES OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA						SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
	WESTERN MUNICIPAL WATER DISTRICT	EASTERN MUNICIPAL WATER DISTRICT	CHINO BASIN MUNICIPAL WATER DISTRICT	POMONA * VALLEY MUNICIPAL WATER DISTRICT	ORANGE * COUNTY MUNICIPAL WATER DISTRICT	TOTAL	
WATER SERVICE AREA							
URBAN AND SUBURBAN							
RESIDENTIAL	17,640	6,920	12,730	3,440	0	40,730	23,260
RECREATIONAL RESIDENTIAL	10	**	0	0	0	10	0
COMMERCIAL	2,380	950	2,220	890	0	6,440	3,550
INDUSTRIAL	560	120	740	180	0	1,600	670
UNSEGREGATED URBAN AND SUBURBAN	3,560	3,900	5,020	390	0	12,870	3,400
SUBTOTALS	24,150	11,890	20,710	4,900	0	61,650	30,880
INCLUDED NONWATER SERVICE AREA	29,700	13,770	27,290	3,510	0	74,270	31,400
GROSS URBAN AND SUBURBAN AREA	53,850	25,660	48,000	8,410	0	135,920	62,280
IRRIGATED AGRICULTURE							
ALFALFA	3,460	8,490	4,010	170	0	16,130	600
PASTURE	5,610	3,030	5,970	10	0	14,620	1,110
CITRUS AND SUBTROPICAL	21,370	3,560	8,100	670	0	33,700	17,160
TRUCK CROPS	4,040	9,500	4,700	100	0	18,340	430
FIELD CROPS	2,190	700	3,480	0	0	6,370	140
DECIDUOUS FRUITS AND NUTS	850	2,710	270	0	0	3,830	470
SMALL GRAIN	200	18,930	310	330	0	19,770	1,050
VINEYARDS	1,620	0	19,640	0	0	21,260	2,600
SUBTOTALS	39,340	46,920	46,480	1,280	0	134,020	23,560
FALLOW	820	7,180	690	0	0	8,690	360
INCLUDED NONWATER SERVICE AREA	4,140	5,750	6,300	110	0	16,300	2,190
GROSS IRRIGATED AGRICULTURE	44,300	59,850	53,470	1,390	0	159,010	26,110
GROSS WATER SERVICE AREA	98,150	85,510	101,470	9,800	0	294,930	88,390
NONWATER SERVICE AREA							
NONIRRIGATED AGRICULTURE	6,830	52,110	3,020	30	0	61,990	2,690
NATIVE VEGETATION	32,820	50,050	22,480	740	0	106,090	41,830
UNCLASSIFIED	100,310	66,150	11,300	1,320	70	179,150	15,420
GROSS NONWATER SERVICE AREA	139,960	168,310	36,800	2,090	70	347,230	59,940
TOTALS	238,110	253,820	138,270	11,890	70	642,160	148,330

* PORTION WITHIN STUDY AREA

** LESS THAN FIVE ACRES

Changes in Land Use

Changes in land use within the study area are indicated in Table 6, which lists land use data obtained during both the 1957 and the 1964 surveys. During the period between these surveys, gross urban and suburban area increased by 123,940 acres; gross irrigated agricultural area declined by 14,180 acres; and the total (gross) water service area increased by 109,760 acres.

A comparison of net areas is probably of more significance in assessing the changes in development that have occurred, because of somewhat different mapping criteria used for each survey (i.e., the included nonwater service area for the 1964 survey contains large acreages of vacant urban land). Between 1957 and 1964, net urban and suburban area increased by 44,400 acres, or 72 percent; net irrigated agricultural area declined by 8,200 acres, or 5 percent; and net water service area increased by 36,200 acres, or 16 percent.

A large part of the new urban and suburban acreage is in residential development, which has increased by 30,920 acres -- about 72 percent. Similar increases have been shown by lands devoted to farmsteads, dairies, livestock ranches, parks, and cemeteries (tabulated as "unsegregated urban and suburban" use), as well as commercial and water-using industrial development.

Much of the new urban and suburban development has been at the expense of acreage formerly in deciduous, citrus, and subtropical orchards. Citrus and subtropical usage has decreased somewhat -- by 6,410 acres, or 11 percent; but deciduous usage has declined drastically -- by 9,700 acres, or 64 percent. Acreage in truck crops has also declined markedly --

TABLE 6

COMPARISON OF 1957 AND 1964 LAND USE IN UPPER SANTA ANA RIVER DRAINAGE AREA
BY HYDROLOGIC UNITS AND SUBUNITS

In acres

Category and class of land use	Santa Ana River Unit													
	Middle Santa Ana River subunit		Upper Santa Ana River subunit		San Timoteo subunit		Lake Mathews subunit		San Bernardino Mountain subunit		Colton-Rialto subunit		Unit total	
	1957	1964	1957	1964	1957	1964	1957	1964	1957	1964	1957	1964	1957	1964
WATER SERVICE AREA														
Urban and Suburban														
Residential, including recreational	19,940	33,740	12,400	17,020	1,260	4,910	100	1,020	2,400	3,880	2,000	3,070	38,100	63,640
Commercial	2,970	5,620	1,450	2,840	50	330	10	40	130	520	260	550	4,870	9,900
Industrial	1,130	1,550	360	470	10	*	20	90	0	20	60	70	1,580	2,200
Unsegregated urban and suburban	7,150	9,110	1,430	2,080	830	1,440	190	340	80	190	230	540	9,910	13,700
Subtotals	31,190	50,020	15,640	22,410	2,150	6,680	320	1,490	2,610	4,610	2,550	4,230	54,460	89,440
Included nonwater service area	19,170	64,070	7,750	15,490	1,100	3,570	700	3,890	370	1,370	1,310	7,140	30,400	95,530
Gross urban and suburban area	50,360	114,090	23,390	37,900	3,250	10,250	1,020	5,380	2,980	5,980	3,860	11,370	84,860	184,970
Irrigated Agriculture														
Alfalfa	6,430	7,780	450	330	450	360	70	40	0	0	30	100	7,430	8,610
Pasture	10,620	11,770	1,890	730	630	550	30	0	10	10	300	20	13,480	13,080
Citrus and subtropical	32,410	27,130	17,250	14,580	680	610	1,330	4,230	10	0	2,050	780	53,730	47,330
Truck crops	17,820	9,340	860	70	110	10	50	40	0	0	110	120	18,950	9,580
Field crops	4,430	5,770	140	90	*	0	0	0	0	0	0	10	4,570	5,870
Deciduous fruits and nuts	3,320	450	270	100	4,450	1,350	30	20	20	10	100	40	8,190	1,970
Small grains	950	840	170	880	190	270	70	10	0	0	0	0	1,380	2,000
Vineyards	14,230	22,960	1,040	560	110	0	10	0	0	0	920	620	16,310	24,140
Subtotals	90,210	86,040	22,070	17,340	6,620	3,150	1,590	4,340	40	20	3,510	1,690	124,040	112,580
Included nonwater service area and fallow	13,090	12,140	2,180	1,510	490	590	1,110	520	*	*	990	340	17,860	15,100
Gross irrigated agriculture	103,300	98,180	24,250	18,850	7,110	3,740	2,700	4,860	40	20	4,500	2,030	141,900	127,680
GROSS WATER SERVICE AREA	153,660	212,270	47,640	56,750	10,360	13,990	3,720	10,240	3,020	6,000	8,360	13,400	226,760	312,650

*Less than 5 acres

COMPARISON OF 1957 AND 1964 LAND USE IN UPPER SANTA ANA RIVER DRAINAGE AREA
BY HYDROLOGIC UNITS AND SUBUNITS
(continued)

In acres

Category and class of land use	San Jacinto Valley Unit								Study Area total	
	Elsinore subunit		Perris subunit		San Jacinto subunit		Unit total			
	1957	1964	1957	1964	1957	1964	1957	1964	1957	1964
WATER SERVICE AREA										
Urban and Suburban										
Residential, including recreational	580	1,360	2,190	5,600	2,390	3,580	5,160	10,540	43,260	74,180
Commercial	80	170	440	790	400	590	920	1,550	5,790	11,450
Industrial	*	*	110	170	20	20	130	190	1,710	2,390
Unsegregated urban and suburban	270	180	530	3,130	410	1,250	1,210	4,560	11,120	18,260
Subtotals	930	1,710	3,270	9,690	3,220	5,440	7,420	16,840	61,880	106,280
Included nonwater service area	300	1,290	1,930	13,750	1,050	2,650	3,280	17,690	33,680	113,220
Gross urban and suburban area	1,230	3,000	5,200	23,440	4,270	8,090	10,700	34,530	95,560	219,500
Irrigated Agriculture										
Alfalfa	0	30	7,210	7,200	1,120	1,400	8,330	8,630	15,760	17,240
Pasture	110	60	2,220	1,330	2,020	1,740	4,350	3,130	17,830	16,210
Citrus and subtropical	790	430	2,070	1,780	1,170	1,810	4,030	4,020	57,760	51,350
Truck crops	390	40	9,780	8,950	1,220	440	11,390	9,430	30,340	19,010
Field crops	0	0	370	700	40	0	410	700	4,980	6,570
Deciduous fruit and nuts	1,280	660	2,690	850	2,950	1,930	6,920	3,440	15,110	5,410
Small grains	0	70	8,910	17,370	1,430	2,270	10,340	19,710	11,720	21,710
Vineyards	20	0	10	0	0	0	30	0	16,340	24,140
Subtotals	2,590	1,290	33,260	38,180	9,950	9,590	45,800	49,060	169,840	161,640
Included nonwater service area	1,720	150	12,880	10,930	1,880	2,180	16,480	13,260	34,340	28,360
Gross irrigated agriculture	4,310	1,440	46,140	49,110	11,830	11,770	62,280	62,320	204,180	190,000
GROSS WATER SERVICE AREA	5,540	4,440	51,340	72,550	16,100	19,860	72,980	96,850	299,740	409,500

*Less than 5 acres

11,330 acres, or 37 percent. On the other hand, irrigated acreage devoted to small grains is up 85 percent, or 9,990 acres, and that devoted to vineyards is up 48 percent, or 7,800 acres. However, these increases probably do not represent new acreage going into production but rather formerly nonirrigated areas changing to an irrigated condition.

The changes in the uses of land that have occurred in the study area during this seven-year period are pointed up on Plates 4A, 4B, and 4C. Major changes in land use occurring in each hydrologic unit are discussed in the following sections.

Santa Ana River Unit

Between 1957 and 1964, net urban and suburban area in the Santa Ana River Unit has expanded by 34,980 acres, or 64 percent; net irrigated agricultural acreage has declined by 11,460 acres, or 9 percent; and net water service area has increased by 23,520 acres, or 13 percent.

All categories of net urban and suburban land use increased by considerable amounts, ranging from a 38 percent gain in unsegregated urban and suburban area to a 103 percent increase in commercial land use. Although net irrigated agriculture experienced only a moderate acreage decline, the crop pattern has changed since 1957. Truck crops and deciduous fruits and nuts have all declined drastically -- by 15,590 acres, or almost 58 percent. There has been a moderate decline in citrus and subtropical acreage throughout the unit except in the vicinity of Lake Mathews. The Lake Mathews Subunit was the only one within the Santa Ana River Unit to show any increase in agricultural acreage; and nearly all of this increase was in citrus and subtropical orchards.

A substantial increase -- 8,450 acres, or 48 percent -- has taken place in irrigated small grains and irrigated vineyards, although this increase was probably the result of these crops going from a non-irrigated to an irrigated condition rather than the result of new plantings. Practically all the reported increase in these crops occurred in the Middle Santa Ana River Subunit. Alfalfa and field crops showed moderate acreage increases, while irrigated pasture remained about the same.

San Jacinto Valley Unit

The San Jacinto Valley Unit has experienced an increase in net water service area of 12,680 acres, or 24 percent, between the years 1957 and 1964. Irrigated agriculture has increased moderately -- by 3,260 acres, or 7 percent, while net urban and suburban area has increased greatly -- by 9,420 acres, or 127 percent.

All categories of urban and suburban land use increased substantially, ranging from a 46 percent gain in industrial land use to a 277 percent increase in unsegregated urban and suburban land use. Acreage in deciduous fruit and nuts has declined by 3,480 acres, or 50 percent. Acreage in small grains has increased by 9,370 acres, or 91 percent, probably as a result of going from a nonirrigated to an irrigated condition. Other crops have shown relatively moderate acreage increases or decreases.

The only subunit that actually increased in agricultural acreage was the Perris Subunit. The Elsinore Subunit was the only one within the entire study area that experienced a decline in water service area; apparently its substantial increase in urban and suburban acreage was more than offset by the decrease in irrigated agriculture.

LAKE ELSINORE

Spence Air Photos

In February 1964, surplus Colorado River water was purchased from the Metropolitan Water District for recreational purposes.

CHAPTER IV. WATER USE

To estimate the 1964 level of water use, the land use data reported in Chapter IV were used with the unit values assigned to the various types of water use (as described in Appendix C). The results of this computation are presented in this chapter plus a comparison of these estimates with those from the 1957 survey. In addition, this indicated demand is compared with the known supply.

Estimates of 1964 Net Water Use

The level of net water use in the Upper Santa Ana River Drainage Area under 1964 conditions of development and under normal precipitation and climatic conditions is presented in this section. Net water use was estimated by applying mean seasonal unit values of consumptive use to the net areas of each type of land use.

In water service areas overlying or tributary to free ground water basins, the investigators assumed that all applied water in excess of consumptive use requirements, except the portions of sewage and industrial waste exported from the area, returns to ground water storage and is available for reuse. The net water use for such an area was estimated to be the sum of the consumptive use of applied water plus sewage export.

In water service areas overlying or tributary to confined ground water basins, they assumed that applied water in excess of consumptive use would return to ground water storage in downstream unconfined basins within the hydrologic unit. Therefore, net water use for these areas was computed in the same manner as that for free ground water areas.

A special survey was made to determine industrial water use. Data were obtained through interviews at major industrial sites within the study area. Establishments contacted included food processing and packing plants, power generation plants, and various other industries that use large quantities of water. Where known, the actual water use of these industrial establishments was used to determine net water use rather than the unit values previously described.

In addition, residential unit water use values utilized in Department of Water Resources Bulletin No. 71 were modified to reflect present land use mapping practice. A detailed description of the method used to estimate net water use is presented in Appendix C, together with a brief discussion of unit water use. Unit values of water use for the study area are presented in Tables C-1 and C-2 in Appendix C.

The estimated levels of mean seasonal net water use in the Upper Santa Ana River Drainage Area for 1964 conditions are presented in Table 7. For comparison, values estimated for 1957 conditions are also given. As indicated in the first part of this chapter, the unit values used to derive the net water use represent the optimum needs of the various types of water-using developments for average conditions of precipitation and climate. The actual net water use for a specific year may have differed from the estimated values reported here because of variations from the mean, but the estimates presented indicate the general level of water use. Mean annual precipitation recorded at climatological stations in San Bernardino, Claremont, and Elsinore over a 30-year period were 17.71, 18.05, and 11.58 inches, respectively. During the water year 1956-57, the average precipitation was 75 percent of the 30-year mean

precipitation for these stations, and for the water year 1963-64 was 60 percent of the mean. Therefore, although the estimates of levels of net water use shown in Table 7 are probably on the low side as compared to actual water use, the difference between estimates for the two years shown is considered to be a good estimate of the change in water use during the period.

TABLE 7

ESTIMATED LEVELS OF NET WATER USE IN
UPPER SANTA ANA RIVER DRAINAGE AREA
FOR CONDITIONS OF DEVELOPMENT IN 1957 AND 1964

In acre-feet

Unit	1957*	1964	Changes
Santa Ana River Unit			
Irrigated Lands	192,200	173,900	-18,300
Urban-Suburban Areas	82,200	114,500	+32,300
Subtotal	274,400	288,400	+14,000
San Jacinto Valley Unit			
Irrigated Lands	75,300	72,400	- 2,900
Urban-Suburban Areas	10,200	16,300	+ 6,100
Subtotal	85,500	88,700	+ 3,200
Total Investigational Area			
Irrigated Lands	267,500	246,300	-21,200
Urban-Suburban Areas	92,400	130,800	+38,400
TOTAL	359,900	377,100	+17,200

*Adjusted to conform to 1964 study area boundaries.

Net water use data presented in this report reflect the changes in land use presented in Chapter III. The estimated seasonal net water use for 1964 was 377,100 acre-feet; this was an increase of almost 5 percent,

or 17,200 acre-feet, above that of 1957. Urban-suburban water use increased by 38,400 acre-feet, almost 42 percent, while water use by irrigated agriculture decreased 21,200 acre-feet, or 8 percent.

Comparison with Water Supply

As was pointed out earlier, the water supply for the study area comes from ground water, surface water (to a small extent), and, recently, the Colorado River. For the discussion that follows, the ground water and surface water were combined as local water. The approximate mean annual safe yield of the local supply was estimated to be 266,000 acre-feet. This value reflects hydrologic conditions for the long-time mean prior to the 1944-45 season and does not reflect the possible lowering effect of the extended drought which has continued in the investigated area since then.

The net water use determined from land use surveys conducted in the Upper Santa Ana River Drainage Area beginning with 1912, together with the excess of net use over the mean annual net local supply and the import for each survey year, is given in Table 8. Also included in Table 8 is the forecast net water requirement for the year 2020 as derived from current Department studies. The export of sewage has been added to the net water use value. In 1957, this amounted to about 3,000 acre-feet. In 1964, this value had reached 9,500 acre-feet. The imports shown in Table 8 do not include water imported to the Santa Ana River Unit from adjacent ground water basins in Los Angeles County. Review of data in the files of the Department of Water Resources indicates that these imports are small when compared to supplies imported through facilities of The Metropolitan Water District of Southern California.

TABLE 8

COMPARISON OF NET WATER USE AND WATER SUPPLY
OF THE UPPER SANTA ANA RIVER DRAINAGE AREA

In acre-feet

Date of survey	Net water use	Approximate mean annual safe yield of local water supply	Excess of water use over mean annual net local water supply	Imports from Colorado River
1912	211,000	266,000	0	0
1926	305,800	266,000	39,800	0
1932	285,400	266,000	19,400	0
1942	305,100	266,000	39,100	0
1948	339,400	266,000	73,400	70
1957	359,900	266,000	93,900	45,000
1964	377,100	266,000	111,100	100,400
2020*	1,263,000	266,000	997,000	--

*Projected

The data in Table 8 indicate that sometime between 1912 and 1926, the net water use in the Upper Santa Ana River Drainage Area began to exceed the combined approximate mean annual safe yield of local water supply and imported supply, and that this condition has continued to the present. The deficiency in local supplies has been met by overdraft of the ground water basins, and, in recent years, by increasing amounts of imported water. A discussion of water imports is contained in Chapter III.

By the year 2020, the estimated total seasonal water requirement for the Upper Santa Ana River Drainage Area, as derived from current Department planning studies, may be as much as 1,263,000 acre-feet. Of this requirement, nearly one million acre-feet will have to be obtained by importing supplies from outside the area of investigation. The expected increase in water requirement between the present and the year 2020 will

result from the development and consequent water service to land currently not receiving water service.

In the development of estimates of future requirements for water, particularly for urban areas, the value of the requirement can fluctuate very substantially, depending upon the assumptions made, particularly with respect to the disposition of sewage. The estimated requirement for the year 2020, presented above, was based on the assumption that additional facilities will be constructed to export sewage from the study area. An earlier estimate derived in Bulletin No. 78 for the year 2020, based upon the assumption that very little sewage export from the area would occur, indicated that the annual level of water use might be only 720,500 acre-feet.

Experience has indicated that, as areas approach a high degree of urbanization, asthetic conditions force the disposal of sewage to the ocean. It is recognized that the collection and central disposal of sewage is required in many areas to avoid public health problems, and that the export of a certain amount of sewage, together with various industrial waste, is necessary to maintain salt balance in ground water bodies. The derivation of the volume of such waste that is required to prevent adverse salt balance is beyond the scope of this investigation. However, the foregoing estimates of future water requirement illustrate the extent to which the development of facilities for reclamation and local use of waste waters and for ocean disposal of sewage can affect water needs. It is, therefore, indicated that any such estimates may be subject to considerable modification, depending upon the ultimate sewerage system developed for the drainage area.

Regardless of the degree of development of facilities for ocean disposal of sewage in the Upper Santa Ana River Drainage Area, estimates of water requirement presented above indicate that a large increase in the volume of water imported to the area will be required to meet forecast demands.

APPENDIX A

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964

TABLE A-1

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964

IN ACRES

CATEGORY AND CLASS OF LAND USE	SANTA ANA RIVER UNIT						
	MIDDLE SANTA ANA RIVER SUBUNIT						
	CHINO SUBAREA	HARRISON SUBAREA	CLAREMONT HEIGHTS SUBAREA	CUCAMONGA SUBAREA	TEMESCAL SUBAREA	ARLINGTON SUBAREA	RIVERSIDE SUBAREA
WATER SERVICE AREA							
URBAN AND SUBURBAN							
RESIDENTIAL	17,920	720	370	400	2,540	4,440	7,270
RECREATIONAL RESIDENTIAL	0	0	80	0	0	0	0
COMMERCIAL	3,160	260	40	60	380	530	1,190
INDUSTRIAL	970	20	0	10	180	40	330
UNSEGREGATED URBAN AND SUBURBAN	6,170	50	100	260	720	520	1,290
SUBTOTALS	28,220	1,050	590	730	3,820	5,530	10,080
INCLUDED NONWATER SERVICE AREA	34,840	640	1,190	1,270	5,350	5,300	15,480
GROSS URBAN AND SUBURBAN AREA	63,060	1,690	1,780	2,000	9,170	10,830	25,560
IRRIGATED AGRICULTURE							
ALFALFA	6,490	0	0	0	320	610	360
PASTURE	8,850	0	*	0	660	560	1,700
CITRUS AND SUBTROPICAL	5,740	50	1,160	2,500	5,820	7,270	4,590
TRUCK CROPS	7,800	0	90	40	520	420	470
FIELD CROPS	4,940	0	0	10	330	380	110
DECIDUOUS FRUITS AND NUTS	240	0	0	50	100	50	10
SMALL GRAIN	690	0	0	0	0	30	120
VINEYARDS	22,030	0	0	610	0	0	320
SUBTOTALS	56,780	50	1,250	3,210	7,750	9,320	7,680
FALLOW	960	0	0	10	110	290	270
INCLUDED NONWATER SERVICE AREA	7,390	*	100	350	860	830	970
GROSS IRRIGATED AGRICULTURE	65,130	50	1,350	3,570	8,720	10,440	8,920
GROSS WATER SERVICE AREA	128,190	1,740	3,130	5,570	17,890	21,270	34,480
NONWATER SERVICE AREA							
NONIRRIGATED AGRICULTURE	5,120	0	0	30	1,000	260	1,900
NATIVE VEGETATION	25,840	0	1,610	3,250	3,910	2,010	4,420
UNCLASSIFIED	28,040	0	16,910	9,170	13,930	20,220	13,030
GROSS NONWATER SERVICE AREA	59,000	0	18,520	12,450	18,840	22,490	19,350
TOTALS	187,190	1,740	21,650	18,020	36,730	43,760	53,830

* LESS THAN FIVE ACRES

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964
(CONTINUED)

IN ACRES

CATEGORY AND CLASS OF LAND USE	SANTA ANA RIVER UNIT								
	UPPER SANTA ANA RIVER SUBUNIT								
	CAJON SUBAREA	BUNKER HILL SUBAREA	REDLANDS SUBAREA	MENTONE SUBAREA	RESERVOIR SUBAREA	CRAFTON SUBAREA	SANTA ANA CANYON SUBAREA	MILL CREEK SUBAREA	SYCAMORE SUBAREA
WATER SERVICE AREA									
URBAN AND SUBURBAN									
RESIDENTIAL	20	12,570	1,300	300	670	720	0	260	160
RECREATIONAL RESIDENTIAL	0	650	0	0	0	0	*	370	0
COMMERCIAL	20	2,400	280	40	10	30	0	40	20
INDUSTRIAL	0	400	10	40	0	0	0	10	10
UNSEGREGATED URBAN AND SUBURBAN	80	1,650	120	40	50	90	0	*	50
SUBTOTALS	120	17,670	1,710	420	730	840	*	680	240
INCLUDED NONWATER SERVICE AREA	20	12,890	660	400	390	500	10	190	430
GROSS URBAN AND SUBURBAN AREA	140	30,560	2,370	820	1,120	1,340	10	870	670
IRRIGATED AGRICULTURE									
ALFALFA	0	320	0	0	0	0	0	0	10
PASTURE	50	530	30	0	0	10	0	0	110
CITRUS AND SUBTROPICAL	0	9,200	1,970	1,030	1,230	290	20	770	70
TRUCK CROPS	0	70	0	0	0	0	0	0	0
FIELD CROPS	0	90	0	0	0	0	0	0	0
DECIDUOUS FRUITS AND NUTS	50	30	10	0	0	10	0	0	0
SMALL GRAIN	0	850	0	10	0	0	0	10	10
VINEYARDS	0	270	0	0	0	0	0	0	290
SUBTOTALS	100	11,360	2,010	1,040	1,230	310	20	780	490
FALLOW	0	130	0	0	0	0	0	90	0
INCLUDED NONWATER SERVICE AREA	10	860	130	50	70	80	*	50	40
GROSS IRRIGATED AGRICULTURE	110	12,350	2,140	1,090	1,300	390	20	920	530
GROSS WATER SERVICE AREA	250	42,910	4,510	1,910	2,420	1,730	30	1,790	1,200
NONWATER SERVICE AREA									
NONIRRIGATED AGRICULTURE	10	880	30	0	0	0	0	30	0
NATIVE VEGETATION	14,920	17,350	700	890	260	1,270	880	2,200	2,940
UNCLASSIFIED	20,530	61,750	10	60	10	1,050	19,800	27,380	1,880
GROSS NONWATER SERVICE AREA	35,460	79,980	740	950	270	2,320	20,680	29,610	4,820
TOTALS	35,710	122,890	5,250	2,860	2,690	4,050	20,710	31,400	6,020

* LESS THAN FIVE ACRES

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964
(CONTINUED)

IN ACRES

CATEGORY AND CLASS OF LAND USE	SANTA ANA RIVER UNIT								
	SAN TIMOTEO SUBUNIT								
	YUCAIPA SUBAREA	SAN TIMOTEO SUBAREA	CHERRY VALLEY SUBAREA	CHICKEN HILL SUBAREA	GATEWAY SUBAREA	OAK GLEN SUBAREA	SOUTH MESA SUBAREA	TRIPLE FALLS SUBAREA	NOBIE CREEK SUBAREA
WATER SERVICE AREA									
URBAN AND SUBURBAN									
RESIDENTIAL	820	380	490	360	30	600	1,650	40	380
RECREATIONAL RESIDENTIAL	0	20	0	0	0	0	10	120	10
COMMERCIAL	20	90	10	30	0	90	60	20	10
INDUSTRIAL	0	*	0	0	0	*	0	0	0
UNSEGREGATED URBAN AND SUBURBAN	80	410	210	50	80	90	240	170	110
SUBTOTALS	920	900	710	440	110	780	1,960	350	510
INCLUDED NONWATER SERVICE AREA	390	660	550	190	30	360	1,120	60	210
GROSS URBAN AND SUBURBAN AREA	1,310	1,560	1,260	630	140	1,140	3,080	410	720
IRRIGATED AGRICULTURE									
ALFALFA	0	310	40	0	0	0	0	10	0
PASTURE	10	500	20	0	0	0	10	10	*
CITRUS AND SUBTROPICAL	320	190	0	10	30	*	60	0	0
TRUCK CROPS	0	0	0	0	0	0	*	0	10
FIELD CROPS	0	0	0	0	0	0	0	0	0
DECIDUOUS FRUITS AND NUTS	120	90	250	60	50	30	170	230	350
SMALL GRAIN	30	180	0	20	0	30	10	0	0
VINEYARDS	0	0	0	0	0	0	0	0	0
SUBTOTALS	480	1,270	310	90	80	60	250	250	360
FALLOW	0	80	10	0	0	0	0	0	0
INCLUDED NONWATER SERVICE AREA	40	270	30	10	40	*	20	30	60
GROSS IRRIGATED AGRICULTURE	520	1,620	350	100	120	60	270	280	420
GROSS WATER SERVICE AREA	1,830	3,180	1,610	730	260	1,200	3,350	690	1,140
NONWATER SERVICE AREA									
NONIRRIGATED AGRICULTURE	240	6,990	740	330	130	210	980	120	420
NATIVE VEGETATION	2,640	18,860	2,350	270	720	670	2,160	2,050	1,940
UNCLASSIFIED	1,580	960	640	0	330	0	5,500	5,460	7,630
GROSS NONWATER SERVICE AREA	4,660	26,810	3,730	1,600	1,180	880	8,640	7,630	9,990
TOTALS	6,490	29,990	5,340	2,330	1,440	2,080	11,990	8,320	11,130

* LESS THAN FIVE ACRES

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964
(CONTINUED)

IN ACRES

CATEGORY AND CLASS OF LAND USE	SANTA ANA RIVER UNIT							
	LAKE MATHEWS SUBUNIT					SAN BERNARDINO MOUNTAIN SUBUNIT		
	COLDWATER SUBAREA	BEDFORD SUBAREA	CAJALCO SUBAREA	LEE LAKE SUBAREA	TERRA COTTA SUBAREA	BEAR VALLEY SUBAREA	SEVEN OAKS SUBAREA	BALDWIN SUBAREA
WATER SERVICE AREA								
URBAN AND SUBURBAN								
RESIDENTIAL	10	100	510	50	340	340	0	130
RECREATIONAL RESIDENTIAL	0	10	0	0	0	1,720	640	1,050
COMMERCIAL	10	20	10	*	*	410	80	30
INDUSTRIAL	0	60	0	20	10	20	0	0
UNSEGREGATED URBAN AND SUBURBAN	20	110	120	50	40	110	40	40
SUBTOTALS	40	300	640	120	390	2,600	760	1,250
INCLUDED NONWATER SERVICE AREA	10	520	1,870	570	920	800	210	360
GROSS URBAN AND SUBURBAN AREA	50	820	2,510	690	1,310	3,400	970	1,610
IRRIGATED AGRICULTURE								
ALFALFA	0	0	0	40	0	0	0	0
PASTURE	0	0	0	0	0	0	10	0
CITRUS AND SUBTROPICAL	620	2,500	590	390	130	0	0	0
TRUCK CROPS	0	0	0	40	*	0	0	0
FIELD CROPS	0	0	0	0	0	0	0	0
DECIDUOUS FRUITS AND NUTS	*	*	0	20	0	0	10	0
SMALL GRAIN	0	0	0	10	0	0	0	0
VINEYARDS	0	0	0	0	0	0	0	0
SUBTOTALS	620	2,500	590	500	130	0	20	0
FALLOW	0	0	0	0	0	0	0	0
INCLUDED NONWATER SERVICE AREA	30	200	180	100	10	0	*	0
GROSS IRRIGATED AGRICULTURE	650	2,700	770	600	140	0	20	0
GROSS WATER SERVICE AREA	700	3,520	3,280	1,290	1,450	3,400	990	1,610
NONWATER SERVICE AREA								
NONIRRIGATED AGRICULTURE	80	200	530	190	450	0	0	0
NATIVE VEGETATION	1,040	4,090	2,760	3,800	1,770	2,760	0	2,150
UNCLASSIFIED	8,910	23,000	18,420	17,410	10,020	28,480	57,910	19,620
GROSS NONWATER SERVICE AREA	10,030	27,290	21,710	21,400	12,240	31,240	57,910	21,770
TOTALS	10,730	30,810	24,990	22,690	13,690	34,640	58,900	23,380

* LESS THAN FIVE ACRES

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964
(CONTINUED)

IN ACRES

CATEGORY AND CLASS OF LAND USE	SANTA ANA RIVER UNIT					SAN JACINTO VALLEY UNIT	
	COLTON-RIALTO SUBUNIT					ELSINORE SUBUNIT	
	UPPER LYTLE SUBAREA	LOWER LYTLE SUBAREA	UPPER COLTON-RIALTO SUBAREA	COLTON-RIALTO SUBAREA	RECHE SUBAREA	ELSINORE SUBAREA	RAILROAD SUBAREA
WATER SERVICE AREA							
URBAN AND SUBURBAN							
RESIDENTIAL	10	10	*	2,870	50	1,300	60
RECREATIONAL RESIDENTIAL	130	0	0	0	0	0	0
COMMERCIAL	50	10	*	490	*	170	0
INDUSTRIAL	0	0	0	70	0	*	0
UNSEGREGATED URBAN AND SUBURBAN	*	70	40	350	80	170	10
SUBTOTALS	190	90	40	3,780	130	1,640	70
INCLUDED NONWATER SERVICE AREA	60	120	10	6,920	30	1,260	30
GROSS URBAN AND SUBURBAN AREA	250	210	50	10,700	160	2,900	100
IRRIGATED AGRICULTURE							
ALFALFA	0	0	0	100	0	30	0
PASTURE	0	0	0	20	0	60	0
CITRUS AND SUBTROPICAL	0	0	10	770	0	430	0
TRUCK CROPS	0	0	0	120	0	40	0
FIELD CROPS	0	0	10	0	0	0	0
DECIDUOUS FRUITS AND NUTS	0	20	20	*	0	660	0
SMALL GRAIN	0	0	0	0	0	70	0
VINEYARDS	0	0	0	620	0	0	0
SUBTOTALS	0	20	40	1,630	0	1,290	0
FALLOW	0	0	0	90	10	60	0
INCLUDED NONWATER SERVICE AREA	0	*	20	220	0	90	0
GROSS IRRIGATED AGRICULTURE	0	20	60	1,940	10	1,440	0
GROSS WATER SERVICE AREA	250	230	110	12,640	170	4,340	100
NONWATER SERVICE AREA							
NONIRRIGATED AGRICULTURE	0	0	490	360	0	840	400
NATIVE VEGETATION	2,720	1,460	2,600	3,590	4,050	7,510	300
UNCLASSIFIED	27,310	2,480	1,630	60	2,980	13,760	4,310
GROSS NONWATER SERVICE AREA	30,030	3,940	4,720	4,010	7,030	22,110	5,010
TOTALS	30,280	4,170	4,830	16,650	7,200	26,450	5,110

* LESS THAN FIVE ACRES

LAND USE IN HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS OF THE UPPER SANTA ANA RIVER DRAINAGE AREA, 1964
(CONTINUED)

IN ACRES

CATEGORY AND CLASS OF LAND USE	SAN JACINTO VALLEY UNIT							
	PERRIS SUBUNIT					SAN JACINTO SUBUNIT		
	PERRIS VALLEY SUBAREA	MENIFEE SUBAREA	WINCHESTER SUBAREA	LAKEVIEW SUBAREA	HEMET SUBAREA	SAN JACINTO SUBAREA	HEMET LAKE SUBAREA	BAUTISTA SUBAREA
WATER SERVICE AREA								
URBAN AND SUBURBAN								
RESIDENTIAL	2,730	510	270	240	1,840	1,990	80	*
RECREATIONAL RESIDENTIAL	*	10	0	0	*	1,150	360	0
COMMERCIAL	410	40	20	20	300	430	160	*
INDUSTRIAL	90	0	0	20	60	20	0	0
UNSEGREGATED URBAN AND SUBURBAN	1,510	360	290	240	730	1,150	70	30
SUBTOTALS	4,740	920	580	520	2,930	4,740	670	30
INCLUDED NONWATER SERVICE AREA	10,450	830	360	240	1,870	2,460	180	10
GROSS URBAN AND SUBURBAN AREA	15,190	1,750	940	760	4,800	7,200	850	40
IRRIGATED AGRICULTURE								
ALFALFA	1,680	820	490	2,380	1,830	1,380	20	0
PASTURE	400	10	20	100	800	1,730	10	*
CITRUS AND SUBTROPICAL	1,350	20	0	10	400	1,810	0	0
TRUCK CROPS	5,600	20	630	620	2,080	440	0	0
FIELD CROPS	530	90	0	0	80	0	0	0
DECIDUOUS FRUITS AND NUTS	120	10	0	10	710	1,920	10	0
SMALL GRAIN	8,230	1,680	240	1,930	5,290	2,270	0	0
VINEYARDS	0	0	0	0	0	0	0	0
SUBTOTALS	17,910	2,650	1,380	5,050	11,190	9,550	40	*
FALLOW	4,380	110	90	430	1,350	760	0	0
INCLUDED NONWATER SERVICE AREA	2,800	340	70	550	810	1,420	*	0
GROSS IRRIGATED AGRICULTURE	25,090	3,100	1,540	6,030	13,350	11,730	40	*
GROSS WATER SERVICE AREA	40,280	4,850	2,480	6,790	18,150	18,930	890	40
NONWATER SERVICE AREA								
NONIRRIGATED AGRICULTURE	22,520	9,950	4,720	4,690	2,070	11,240	0	0
NATIVE VEGETATION	12,640	3,370	2,340	1,670	7,870	54,930	6,910	3,060
UNCLASSIFIED	31,560	7,700	5,100	8,010	24,600	101,580	36,230	3,210
GROSS NONWATER SERVICE AREA	66,720	21,020	12,160	14,370	34,540	167,750	43,140	6,270
TOTALS	107,000	25,870	14,640	21,160	52,690	186,680	44,030	6,310

* LESS THAN FIVE ACRES

APPENDIX B

CLASSIFICATION OF LAND USE

APPENDIX B

CLASSIFICATION OF LAND USE

For analysis and presentation, the various land uses are grouped into two major categories under water service areas: (1) Urban and Suburban, and (2) Irrigated Agriculture; and into three major categories under nonwater service areas: (1) Nonirrigated Agriculture, (2) Native Vegetation, and (3) Unclassified. The two categories under water service areas each include several classes of land use. The classes include a number of types of land use--all types within a class requiring similar unit amounts of water.

The major categories, classes, and types of land use in the classification are listed in Table B-1.

TABLE B-1

MAJOR CATEGORIES, CLASSES, AND TYPES OF LAND USE FOR WATER SERVICE AND NONWATER SERVICE AREAS

Category and class of land use	Types of land use
WATER SERVICE AREA	
Urban and Suburban Category	
Residential	Single- and multiple-family houses and apartments, trailer parks, and residential subdivisions under construction at time of survey.
Recreational residential	Weekend summer home tracts, and campgrounds within a primarily recreational area.
Commercial	All classes of commercial enterprises, including strip commercial and downtown commercial areas, schools, hospitals, churches, and motels.
Industrial	All classes of industrial land use involving manufacturing, processing, packaging, but excluding extractive (oil, sand, and gravel), storage, and distribution facilities.
Unsegregated urban and suburban	Dairies, farmsteads, livestock ranches, parks, cemeteries, and golf courses.
Included nonwater service	Oilfields, tank farms, vacant lots, quarries, gravel pits, warehouses, storage yards, railroad rights-of-way, public streets, landing strips of airfields, and miscellaneous paved areas.
Irrigated Agriculture Category	
Alfalfa	Alfalfa raised for hay, seed, or pasture.
Pasture	Irrigated grasses and legumes, other than alfalfa, used for livestock forage.
Citrus and subtropical	Oranges, lemons, grapefruit, avocados, olives, and miscellaneous subtropical fruits.
Truck crops	Vegetables of all varieties, melons, flower seed, and nursery crops.
Field crops	Sugar beets, corn, cotton, flax, and sorghums.
Deciduous fruits and nuts	All varieties of deciduous fruits and nuts.
Small grain	Barley, wheat, and oats.
Vineyards	All varieties of grapes.
Fallow	Land tilled between crops
Included nonwater service	Public highways and roads, farm access roads, canals, and other inclusions not devoted to crop production, including irrigated idle and abandoned lands.
NONWATER SERVICE AREA	
Nonirrigated Agriculture Category	All varieties of dry-farmed crops, including pasture, nonirrigated fallow, and idle, that overlie defined ground water basins.
Native Vegetation Category	Native grasses, brush, and trees, including phreatophytes, that overlie defined ground water basins.
Unclassified Category	Bare ground, including river washes, beaches, and water surfaces, that overlie defined ground water basins; nonirrigated agriculture and native vegetation not overlying defined ground water basins.

In delineating land use types in the field, no attempt was made to exclude such items as streets, roads, railroad and powerline rights-of-way, and other essentially nonwater-using lands occurring within the surveyed areas. Later in the office, these land uses were extracted from overall land use totals by applying to each major land use class a percentage value appropriate for that class. The amounts extracted from gross land use totals were then classified as "included nonwater service area".

During this survey, a brief study was made to reevaluate the percentages for residential and commercial land use classes used in Bulletin No. 71. The appropriate reduction factors for the major classes of land use are presented in Table B-2.

TABLE B-2

FACTORS FOR REDUCTION OF GROSS AREAS TO NET AREAS

Land use	Percent deducted from gross area
Residential	22
Residential (Low density)	10
Commercial	20
Schools	15
Industrial, manufacturing	25
Parks, cemeteries, and golf courses	15
Farmsteads, livestock ranches, and dairies	10
Irrigated agriculture	5

The net acreage values used in the tables summarizing land use represent the gross acreage values minus those portions of the gross values that have been deducted for these included nonwater service areas.

APPENDIX C

UNIT VALUE METHOD FOR ESTIMATING NET WATER USE

APPENDIX C

UNIT VALUE METHOD FOR ESTIMATING NET WATER USE

Wherever none of the applied water in an area is available for reuse, the net water use can be determined by measuring the total applied water. On the other hand, in areas where a portion of the applied water becomes available for reuse, it is not possible to measure the volume of return flow of reusable water. The net water use in these areas must be determined in another manner; therefore, an indirect method is used.

In the indirect method employed in this investigation, estimates of net water use are obtained by multiplying the areas of the various classes of water-using developments by appropriate average values of consumptive use of applied water. These unit values of consumptive use of applied water reflect average conditions of precipitation and the normal practices associated with urban water distribution and with irrigated agriculture.

When using this method for determining net water use, the unit values of consumptive use of water must be clearly correlated with the appropriate land use classes or types (see Appendix B). This is especially critical for residential, industrial, and commercial water uses.

During this investigation, urban and suburban unit values of consumptive use of applied water derived in Bulletins Nos. 2 and 71 were reviewed and were found to be the best available. A complete discussion of the techniques employed in the derivation of units of water use is contained in Bulletin No. 2; therefore, only a general description of those procedures is given here.

TABLE C-1

ESTIMATED MEAN SEASONAL UNIT VALUES OF
CONSUMPTIVE USE OF WATER ON URBAN AND SUBURBAN LANDS,
UPPER SANTA ANA RIVER DRAINAGE AREA

In feet

Land use type	Consumptive use of applied water	Consumptive use of precipitation	Total
Residential, single	1.2	0.9	2.1
Residential, estate	0.9	0.9	1.8
Residential, multiple	0.3	0.6	0.9
Recreational residential	0.2	*	*
Campgrounds	0.1	*	*
Farmsteads	0.8	0.8	1.6
Commercial, strip	0.4	0.5	0.9
Commercial, downtown	1.1	0.5	1.6
Industrial, manufacturing	1.4	0.6	2.0
Industrial, cannery	5.5	0.6	6.1
Industrial, high water using	**	**	**
Schools	0.4	0.7	1.1
Parks, cemeteries, and golf courses	2.5	1.2	3.7
Dairies	1.0	0.9	1.9
Livestock and poultry ranches	0.6	0.7	1.3
Industrial, extractive	--	0.6	0.6
Vacant	--	0.6	0.6
Streets and roads	--	0.5	0.5

*Not determined
**Actual volume of water applied was used to determine water use

Mean seasonal unit values of consumptive use of applied water on urban and suburban lands were estimated for Bulletin No. 2 on the basis of a sampling procedure in which an inventory was made of measured water deliveries to study areas representative of each class or type of land use. For residential and commercial areas, study areas consisting of single blocks devoted entirely to one type of land use were selected. To compute the unit values of water use, an allowance for the applied

water that is disposed of as sewage and returns to the ground water body was deducted, and the remainder was divided by the net sampled area.

The mean seasonal unit values of consumptive use so determined, shown in Table C-1, were utilized to compute net water use in all areas of the investigation. It was assumed that applied water in excess of consumptive use is generally considered to be available for reuse through deep percolation or salvage.

It should be pointed out that, in the derivation of the net water use for any given year, the volume of applied water required is based on the assumption that the precipitation for the season was equal to the long-time mean. However, the use of applied water will actually be somewhat larger or smaller in individual years, varying inversely with the amount of rainfall. A similar effect occurs with urban use; however, the use of precipitation by residential, commercial, and industrial classifications is relatively small. Therefore, variations of rainfall from year to year have a lesser effect upon the use of applied water by these land use classes than by irrigated lands.

Despite the possibility of these variations, the procedures used in this survey are considered by the Department to be the best available, resulting in reasonable values of current levels of water use. Unit seasonal values of consumptive use of water by irrigated crops were derived by a method developed for the U. S. Department of Agriculture by Harry F. Blaney and Wayne D. Criddle. The values thus derived are presented in Table C-2.

TABLE C-2

ESTIMATED MEAN SEASONAL UNIT VALUES
OF CONSUMPTIVE USE OF WATER ON IRRIGATED LANDS,
UPPER SANTA ANA RIVER DRAINAGE AREA

In feet

Land use type	Santa Ana River Unit*			San Jacinto Valley Unit*		
	Applied water	Precipitation	Total	Applied water	Precipitation	Total
Alfalfa	2.4	1.3	3.7	2.7	1.0	3.7
Pasture	2.5	1.2	3.7	2.7	1.0	3.7
Deciduous and nuts	1.6	1.3	2.9	1.9	1.0	2.9
Citrus	1.5	1.1	2.6	1.6	1.0	2.6
Truck crops	1.2	0.9	2.1	1.4	0.7	2.1
Field	1.2	0.9	2.1	1.4	0.7	2.1
Small grain	0.7	1.0	1.7	0.7	1.0	1.7
Vineyard	1.1	1.3	2.4	1.2	1.2	2.4
Streets and roads	--	0.5	0.5	--	0.5	0.5

*The Elsinore Subunit is included with the Santa Ana River Unit because the climatic factors more closely resemble those in that unit than those in the San Jacinto Valley Unit.

APPENDIX D

DEFINITION OF TERMS

APPENDIX D

DEFINITION OF TERMS

Annual - The 12-month period from January 1 of a given year through December 31 of the same year, sometimes termed the "calendar year".

Applied Water - Water delivered to a farmer's headgate, in the case of irrigation use, or to an individual's meter (or its equivalent), in the case of urban use. Applied water does not include direct precipitation. Man applies water to satisfy the requirement for consumptive use in excess of the amount supplied from natural sources. However, as a practical matter, the quantity of water applied is usually in excess of the consumptive use of applied water, and that portion of the water applied to any use that is not consumed or irrecoverably lost remains a part of the water supply.

Average - An arithmetical average relating to a period other than a mean period.

The California Water Plan - A master plan to guide and coordinate the planning and construction by all agencies of works required for the control, protection, conservation, and distribution of California's water resources for the benefit of all areas of the State and for all beneficial purposes.

Confined Ground Water - A body of ground water immediately overlain by material sufficiently impervious to sever free hydraulic connection with overlying water, and acted upon by pressure caused by the difference in head between the intake, or forebay area, and the discharge area of the confined water body.

Consumptive Use of Water - Water from any source consumed by vegetative growth in transpiration and building plant tissue, and water evaporated from adjacent soil, from water surface, and from foliage. It also refers to water similarly consumed or evaporated by urban and nonvegetative types of land use.

Free Ground Water - A body of ground water not immediately overlain by impervious materials.

Gross Area - An area of land use, as mapped in the field, which includes the acreage of streets, roads, railroad and powerline rights-of-way, and other essentially nonwater-using lands.

Ground Water Overdraft - The annual net extraction of water from a ground water basin in excess of safe ground water yield.

Hydrologic Unit* - In this bulletin, a classification embracing one of the following two topographic characteristics, both of which are defined by surface drainage divides:

a. In general, the total watershed area, including water-bearing and nonwater-bearing formations, such as the total drainage area of the San Jacinto River Valley.

b. In coastal areas, two or more small contiguous watersheds having similar hydrologic characteristics and water supply problems, each watershed being directly tributary to the ocean and all watersheds emanating from one mountain body located immediately adjacent to the ocean.

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*The areal designation system, i.e., categorizing areas into units, subunits, and subareas, is designed to separate data according to areas of hydrologic significance. The system, as developed, does not differentiate between ground water-bearing formations and nonground water-bearing tributary areas, although land use, as inventoried, does differentiate between such boundaries.

Hydrologic Subunit* - In this bulletin, a major logical subdivision of a hydrologic unit, including water-bearing and nonwater-bearing formations, best typified by a major tributary of a stream, a major valley, or a plain along a stream containing one or more ground water basins and having closely related geologic, hydrologic, and topographic characteristics.

Hydrologic Subarea* - In this bulletin, a logical subdivision of a hydrologic subunit which may include either water-bearing or nonwater-bearing formations or both. Where possible, a hydrologic subarea includes one known ground water basin and its tributary area; the ground water basin comprising the water-bearing deposits of the subarea. In areas which are essentially nonwater-bearing, the subarea division was based only on surface drainage conditions, and such factors as locations of gaging stations were given due consideration.

Irrecoverable Losses - Such items as disposal or seepage of unconsumed water to bodies of unsuitable quality, including the ocean, and disposal or seepage of unconsumed water in such a manner as to be uneconomical to recapture for use. These irrecoverable losses are incidental to consumptive use of water (defined above).

Irrigation Efficiency - The ratio of consumptive use of applied irrigation water to the total amount of water applied, expressed as a percentage.

Mean - An arithmetical average relating to a mean period.

Mean Period - A period chosen to represent conditions of water supply and climate over a long series of years. For the current investigation, the mean precipitation period embraces the 50 seasons from 1897-98 through 1946-47.

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*See footnote on preceding page.

Net Area - An area of land use less the area in streets, roads, railroad and powerline rights-of-way, and other essentially nonwater-using lands.

Net Water Use - That portion of applied water which is consumptively utilized for beneficial purposes or otherwise irrecoverably lost. It does not include that portion of the applied water which is subject to possible reuse.

Present - The 1963-64 season.

Safe Ground Water Yield - The average annual net amount of water that could be beneficially extracted from a ground water basin over an indefinitely long period of years, under a particular set of those physical conditions affecting supply to and disposal from, the ground water basin, without causing a net lowering of ground water levels during the period.

Seasonal - Any 12-month period other than the calendar year.

Water Use - In the broadest sense, includes all uses of water by nature or by man, whether consumptive or nonconsumptive, as well as irrecoverable losses of water incidental to such employment. It is synonymous with "water utilization".

Water Year - The 12-month period October 1 through September 30.

APPENDIX E

REPORTS ON RELATED INVESTIGATIONS AND OTHER REFERENCES

APPENDIX E

REPORTS ON RELATED INVESTIGATIONS AND OTHER REFERENCES

There are three very important reports which are related to this bulletin:

State Water Resources Board Bulletin No. 2, "Water Utilization and Requirements of California", June 1955. This bulletin was written in preparation of The California Water Plan and contains information on land and water use for the entire State. The land use data is based on a survey made in 1948.

Department of Water Resources Bulletin No. 15, "Santa Ana River Investigation", February 1959. Hydrology of the entire Santa Ana River drainage area was the subject of this report. It contains an inventory of surface and underground water resources along with estimates of ultimate water utilization and requirements. Like Bulletin No. 2, this report is based on the 1948 land use survey.

Department of Water Resources Bulletin No. 71, "Upper Santa Ana River Drainage Area Land and Water Use Survey, 1957", May 1960. This report sets the pattern which Bulletin No. 71-64 follows. Land and water use data here are based on a 1957 survey. The results of the 1957 bulletin have been used extensively in the present report for comparison purposes.

Other references which were helpful throughout the course of this study are presented below:

Bank of America National Trust and Savings Association. "Focus on the San Bernardino-Riverside-Ontario Metropolitan Areas". No date.

California State Department of Public Works, Division of Water Resources. "South Coastal Basin Investigation, Overdraft on Groundwater Basins". Bulletin No. 53. 1947.

California State Department of Water Resources. "Investigation of Alternative Aqueduct Systems to Serve Southern California". Bulletin No. 78, Appendix D, "Economic Demand for Imported Water". March 1960.

California State Office of the Controller. "Annual Report of Financial Transactions Concerning Cities of California, Fiscal Year 1962-63". No date.

Hall, William H., "Report of the State Engineer to the Legislature of the State of California, Session of 1880".

Los Angeles County Regional Planning Commission. "Los Angeles County Statistical Areas and Their Component Tracts (Revised to June 30, 1964)". No date.

----. "Population and Dwelling Units". Quarterly Bulletin No. 86. October 1964.

The Metropolitan Water District of Southern California. "Report for the Fiscal Year, July 1, 1963 to June 30, 1964". Twenty-sixth Annual Report. 1964.

Pomona Valley Municipal Water District. "Waste Water Reclamation Study". May 1960.

Riverside County Department of Agriculture. "Riverside County Agricultural Crop Report". 1964.

Riverside County Planning Commission. "Population Study, Riverside County, California". March 1961.

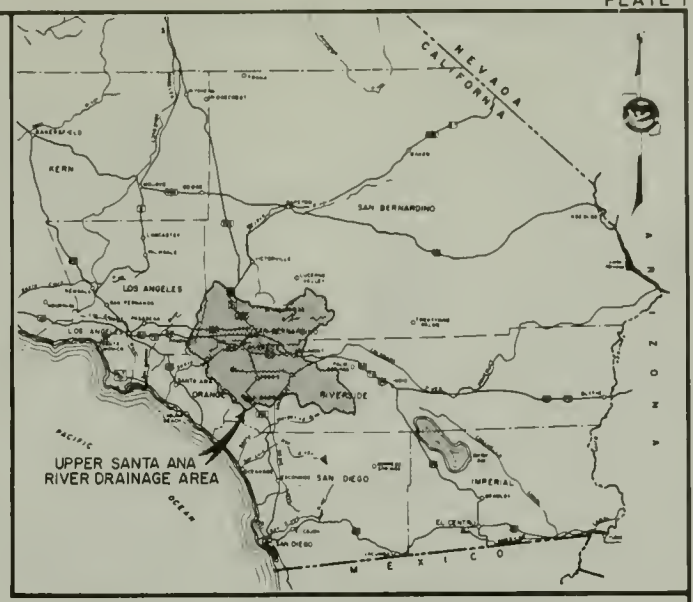
----. "Quarterly Cumulative Population Estimates for October 1, 1964". October 1, 1964.

San Bernardino County Department of Agriculture. "Annual Crop and Livestock Report". 1964.

Security First National Bank. "Southern California Report". January 1965.

United States Department of Agriculture, Forest Service, San Bernardino National Forest. "Report of preliminary engineering of Barton Flats and contiguous Santa Ana River area Water and Sewerage Systems". May 1965.

United States Department of Commerce, Bureau of the Census. "United States Census of Population and Housing 1960 Census Tracts". Final Reports PHC (1) - 135 and PHC (1) - 82. 1962.



LOCATION MAP

LEGEND

BOUNDARY OF INVESTIGATIONAL AREA

BOUNDARY OF HYDROLOGIC UNIT

BOUNDARY OF HYDROLOGIC SUBUNIT

BOUNDARY OF HYDROLOGIC SUBAREA

WATER-BEARING SEDIMENTS

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

HYDROLOGIC UNITS, SUBUNITS, SUBAREAS, AND WATER-BEARING SEDIMENTS

1964

SCALE OF MILES

3 0 3 6 9

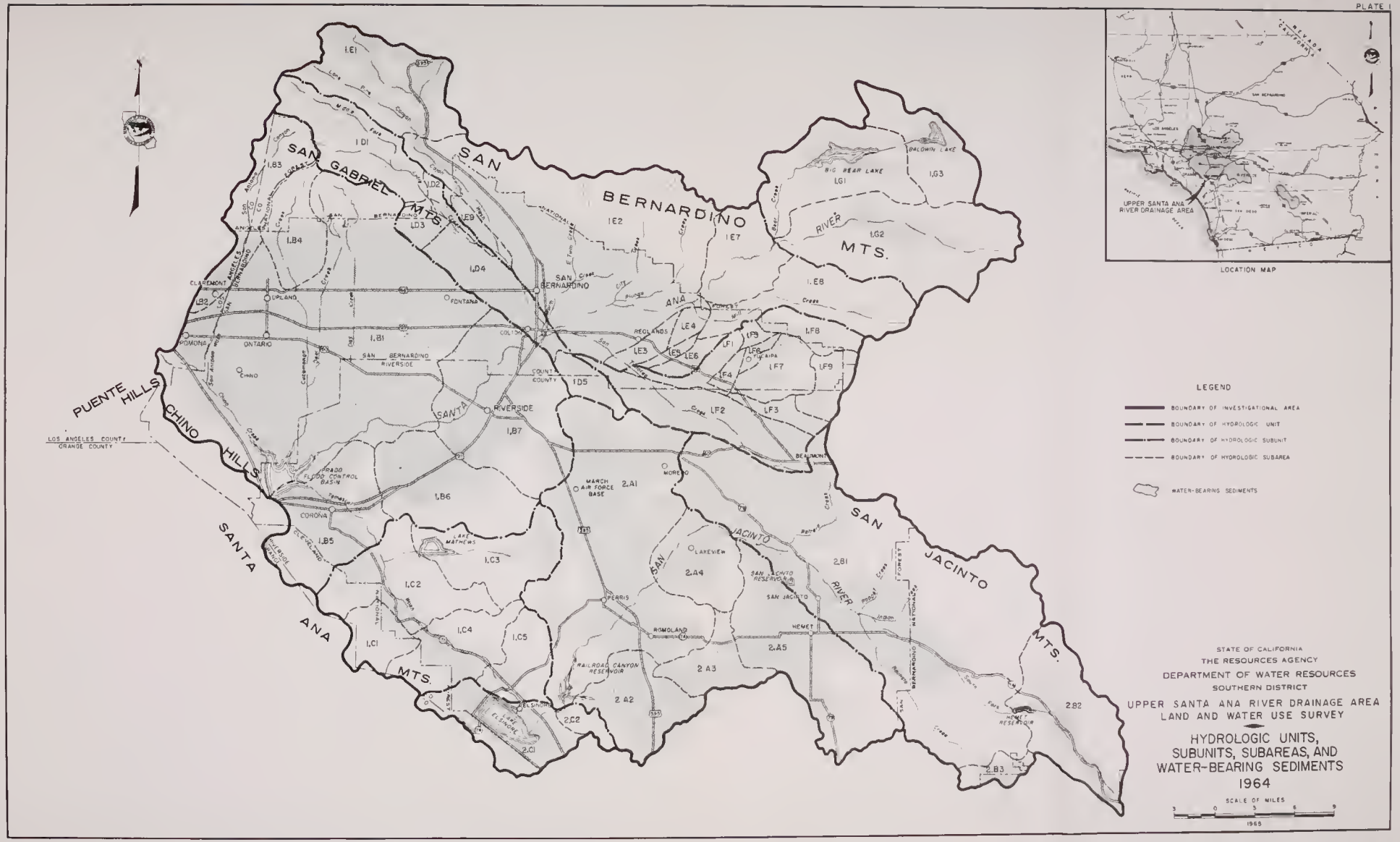
1965

PLATE I

DESIGNATIONS OF HYDROLOGIC UNITS, SUBUNITS, AND SUBAREAS

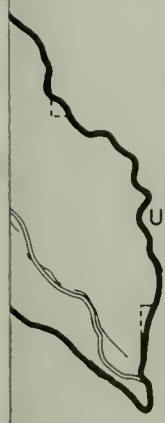
PORTION OF SANTA ANA DRAINAGE PROVINCE

Y-01.00	Santa Ana River Hydrologic Unit
Y-01.B0	Middle Santa Ana River Hydrologic Submit
Y-01.B1	Chino Hydrologic Subarea
Y-01.B2	Harrison Hydrologic Subarea
Y-01.B3	Claremont Heights Hydrologic Subarea
Y-01.B4	Cucamonga Hydrologic Subarea
Y-01.B5	Temescal Hydrologic Subarea
Y-01.B6	Arlington Hydrologic Subarea
Y-01.B7	Riverside Hydrologic Subarea
Y-01.C0	Lake Mathews Hydrologic Subunit
Y-01.C1	Coldwater Hydrologic Subarea
Y-01.C2	Bedford Hydrologic Subarea
Y-01.C3	Cajalco Hydrologic Subarea
Y-01.C4	Lee Lake Hydrologic Subarea
Y-01.C5	Terra Cotta Hydrologic Subarea
Y-01.D0	Colton-Rialto Hydrologic Subunit
Y-01.D1	Upper Lytle Hydrologic Subarea
Y-01.D2	Lower Lytle Hydrologic Subarea
Y-01.D3	Upper Colton-Rialto Hydrologic Subarea
Y-01.D4	Colton-Rialto Hydrologic Subarea
Y-01.D5	Reche Hydrologic Subarea
Y-01.E0	Upper Santa Ana River Hydrologic Subunit
Y-01.E1	Cajon Hydrologic Subarea
Y-01.E2	Bunker Hill Hydrologic Subarea
Y-01.E3	Redlands Hydrologic Subarea
Y-01.E4	Mentone Hydrologic Subarea
Y-10.E5	Reservoir Hydrologic Subarea
Y-01.E6	Crafton Hydrologic Subarea
Y-01.E7	Santa Ana Canyon Hydrologic Subarea
Y-01.E8	Mill Creek Hydrologic Subarea
Y-01.E9	Sycamore Hydrologic Subarea
Y-01.F0	San Timoteo Hydrologic Subunit
Y-01.F1	Yucaipa Hydrologic Subarea
Y-01.F2	San Timoteo Hydrologic Subarea
Y-01.F3	Cherry Valley Hydrologic Subarea
Y-01.F4	Chicken Hill Hydrologic Subarea
Y-01.F5	Gateway Hydrologic Subarea
Y-01.F6	Oak Glen Hydrologic Subarea
Y-01.F7	South Mesa Hydrologic Subarea
Y-01.F8	Triple Falls Creek Hydrologic Subarea
Y-01.F9	Nobie Creek Hydrologic Subarea
Y-01.G0	San Bernardino Mountain Hydrologic Subunit
Y-01.G1	Bear Valley Hydrologic Subarea
Y-01.G2	Seven Oaks Hydrologic Subarea
Y-01.G3	Baldwin Hydrologic Subarea
Y-02.00	San Jacinto Valley Hydrologic Unit
Y-02.A0	Perris Hydrologic Subunit
Y-02.A1	Perris Valley Hydrologic Subarea
Y-02.A2	Menifee Hydrologic Subarea
Y-02.A3	Winchester Hydrologic Subarea
Y-02.A4	Lakeview Hydrologic Subarea
Y-02.A5	Hemet Hydrologic Subarea
Y-02.B0	San Jacinto Hydrologic Subunit
Y-02.B1	San Jacinto Hydrologic Subarea
Y-02.B2	Hemet Lake Hydrologic Subarea
Y-02.B3	Bautista Hydrologic Subarea
Y-02.C0	Elsinore Hydrologic Subunit
Y-02.C1	Elsinore Hydrologic Subarea
Y-02.C2	Railroad Hydrologic Subarea



LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF NATIONAL FOREST
- WESTERN MUNICIPAL WATER DISTRICT
- EASTERN MUNICIPAL WATER DISTRICT
- CHINO BASIN MUNICIPAL WATER DISTRICT
- POMONA VALLEY MUNICIPAL WATER DISTRICT
- SAN BERNARDIND VALLEY MUNICIPAL WATER DISTRICT



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

UPPER SANTA ANA RIVER DRAINAGE AREA LAND AND WATER USE SURVEY

MAJOR WATER SERVICE AGENCIES 1964

SCALE OF MILES

3 0 3 6 9

1965

LEGEND

BOUNDARY OF INVESTIGATIONAL AREA

BOUNDARY OF NATIONAL FOREST

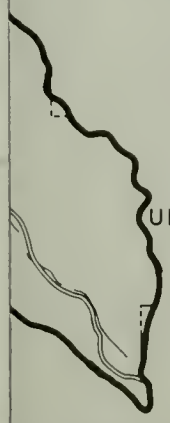
WESTERN MUNICIPAL WATER DISTRICT

EASTERN MUNICIPAL WATER DISTRICT

CHINO BASIN MUNICIPAL WATER DISTRICT

POMONA VALLEY MUNICIPAL WATER DISTRICT

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT



STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

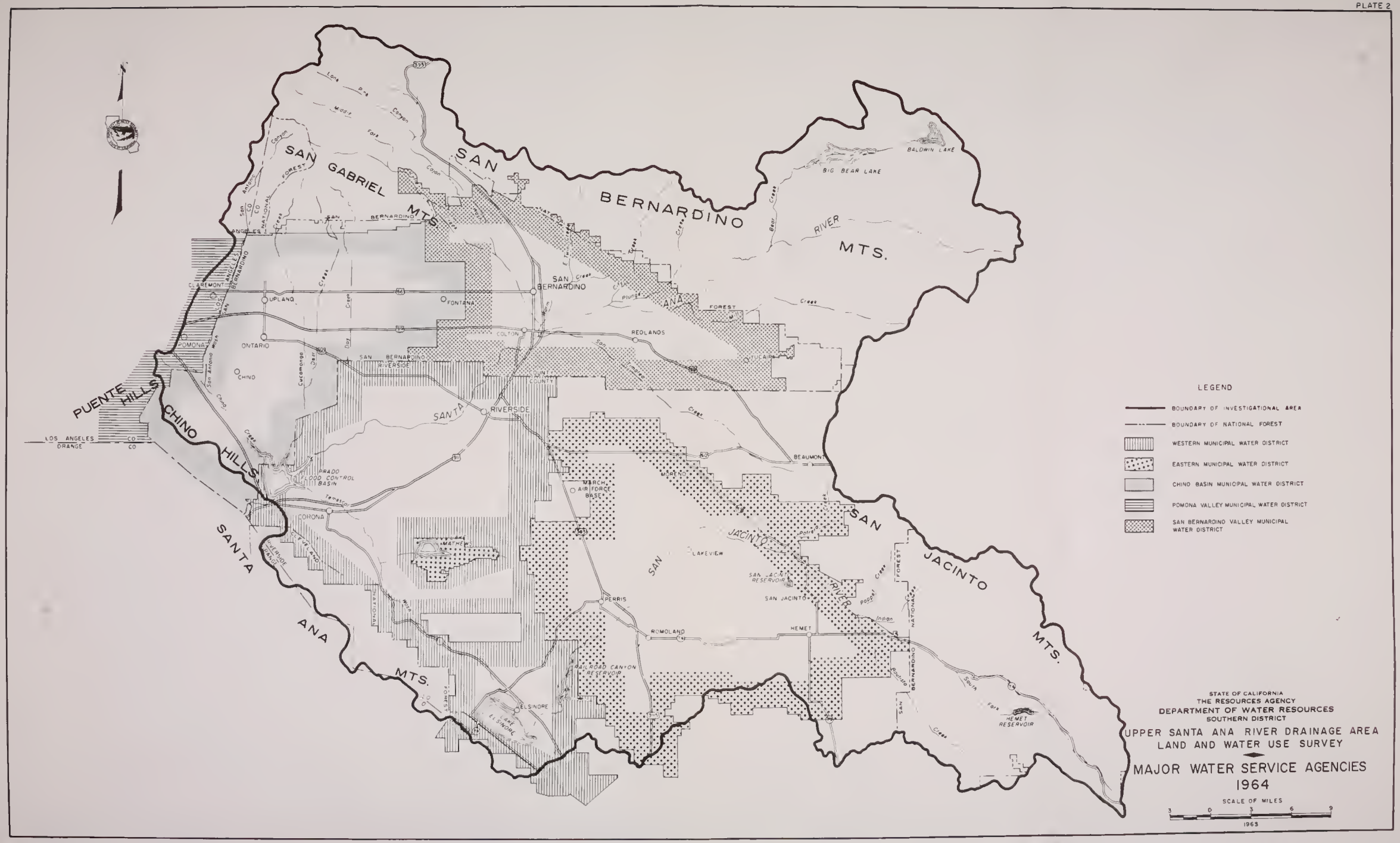
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

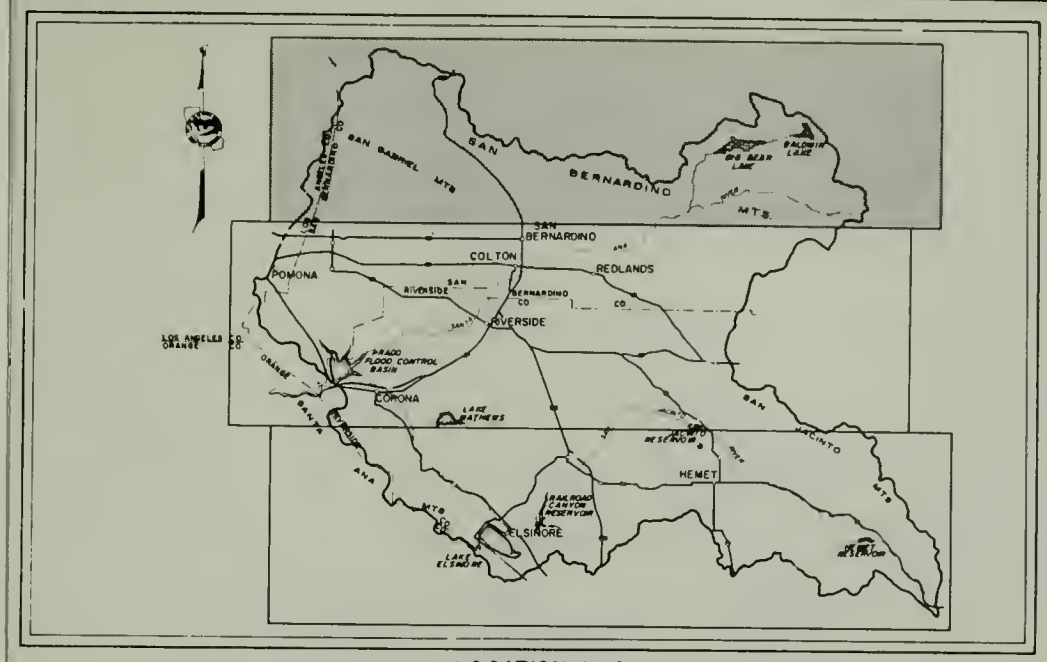
MAJOR WATER SERVICE AGENCIES
1964

SCALE OF MILES

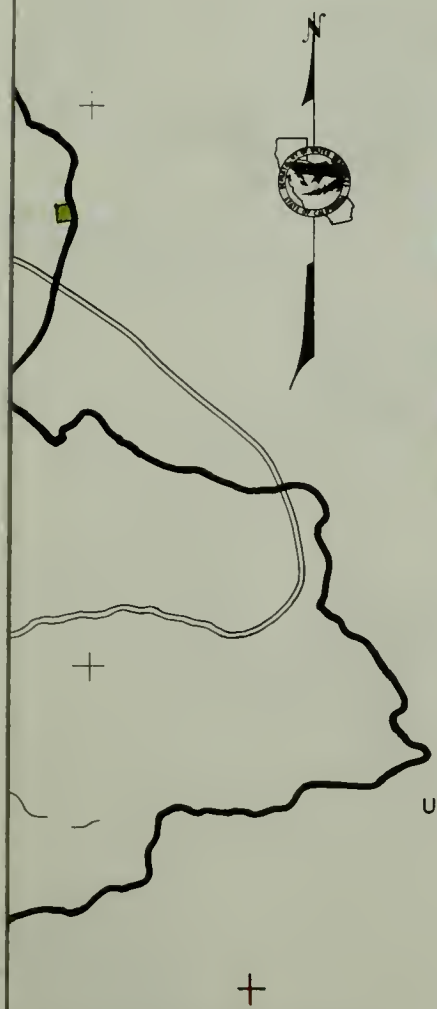
3 0 3 6 9

1965


SAN GABRIEL MTS.
SAN BERNARDINO MTS.
SAN JACINTO MTS.
SANTA ANA MTS.
PUENTE HILLS
CHINO HILLS
SANTA ANA RIVER
SAN JACINTO RIVER
BIG BEAR LAKE
BALDWIN LAKE
SAN BERNARDINO
UPLAND
FONTANA
CLAREMONT
POMONA
ONTARIO
CHINO
COLTON
REDLANDS
YUCAIPA
RIVERSIDE
CORONA
BEAUMONT
MORENO
MARCH AIR FORCE BASE
PRADO FLOOD CONTROL BASIN
LAKEVIEW
SAN JACINTO RESERVOIR
SAN JACINTO
PERRIS
ROMOLAND
HEMET
ELSINORE
LAKE ELSINORE
RAILROAD CANYON RESERVOIR
HEMET RESERVOIR
LOS ANGELES CO
ORANGE CO
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF NATIONAL FOREST
WESTERN MUNICIPAL WATER DISTRICT
EASTERN MUNICIPAL WATER DISTRICT
CHINO BASIN MUNICIPAL WATER DISTRICT
POMONA VALLEY MUNICIPAL WATER DISTRICT
SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
MAJOR WATER SERVICE AGENCIES
1964
SCALE OF MILES
3 0 3 6 9
1963



LOCATION MAP



LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL - MANUFACTURING AND PROCESSING
- INDUSTRIAL - EXTRACTIVE, STORAGE, AND TRANSPORTATION
- IRRIGATED AGRICULTURE
- RECREATION

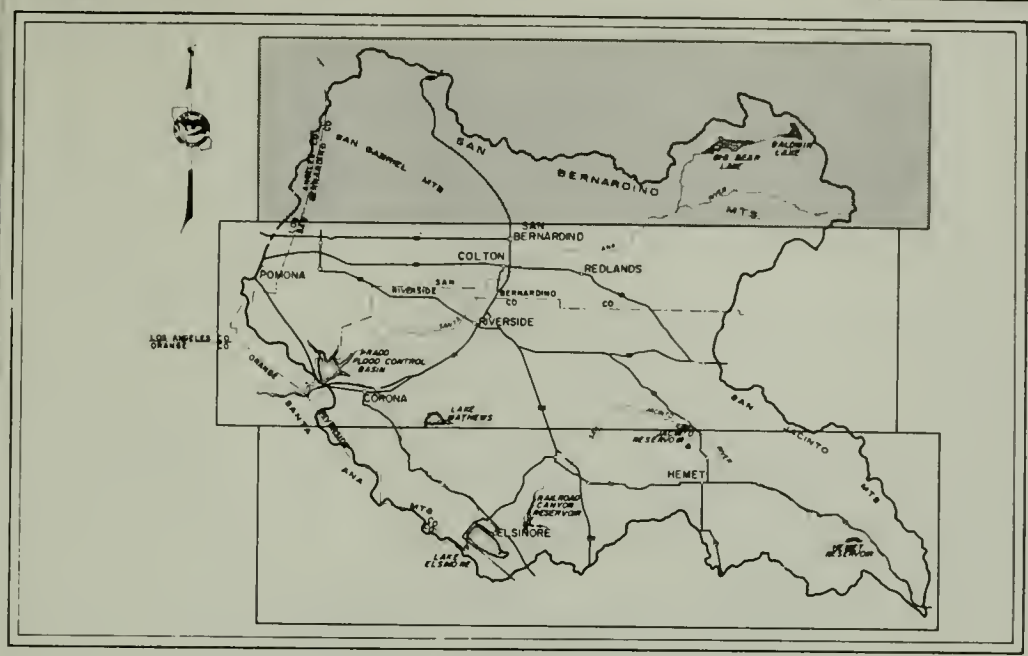
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

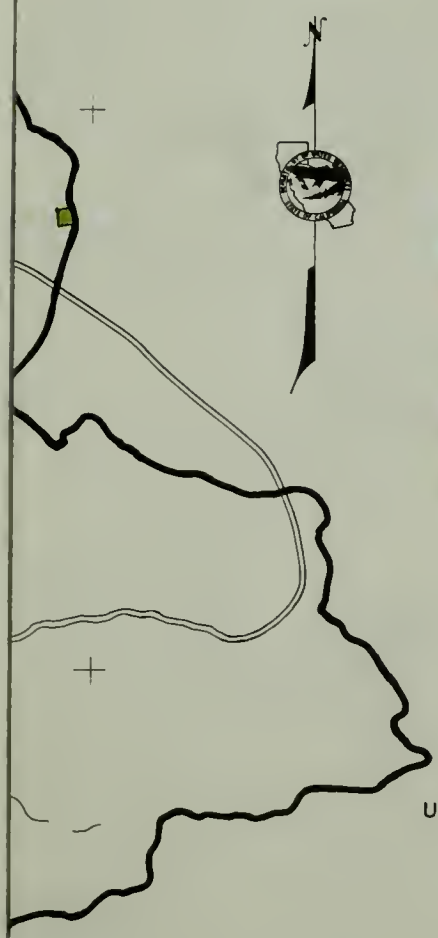
PRESENT LAND USE
1964

SCALE OF MILES
1 0 1 2 3

1965



LOCATION MAP



LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- RESIDENTIAL
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- RECREATION

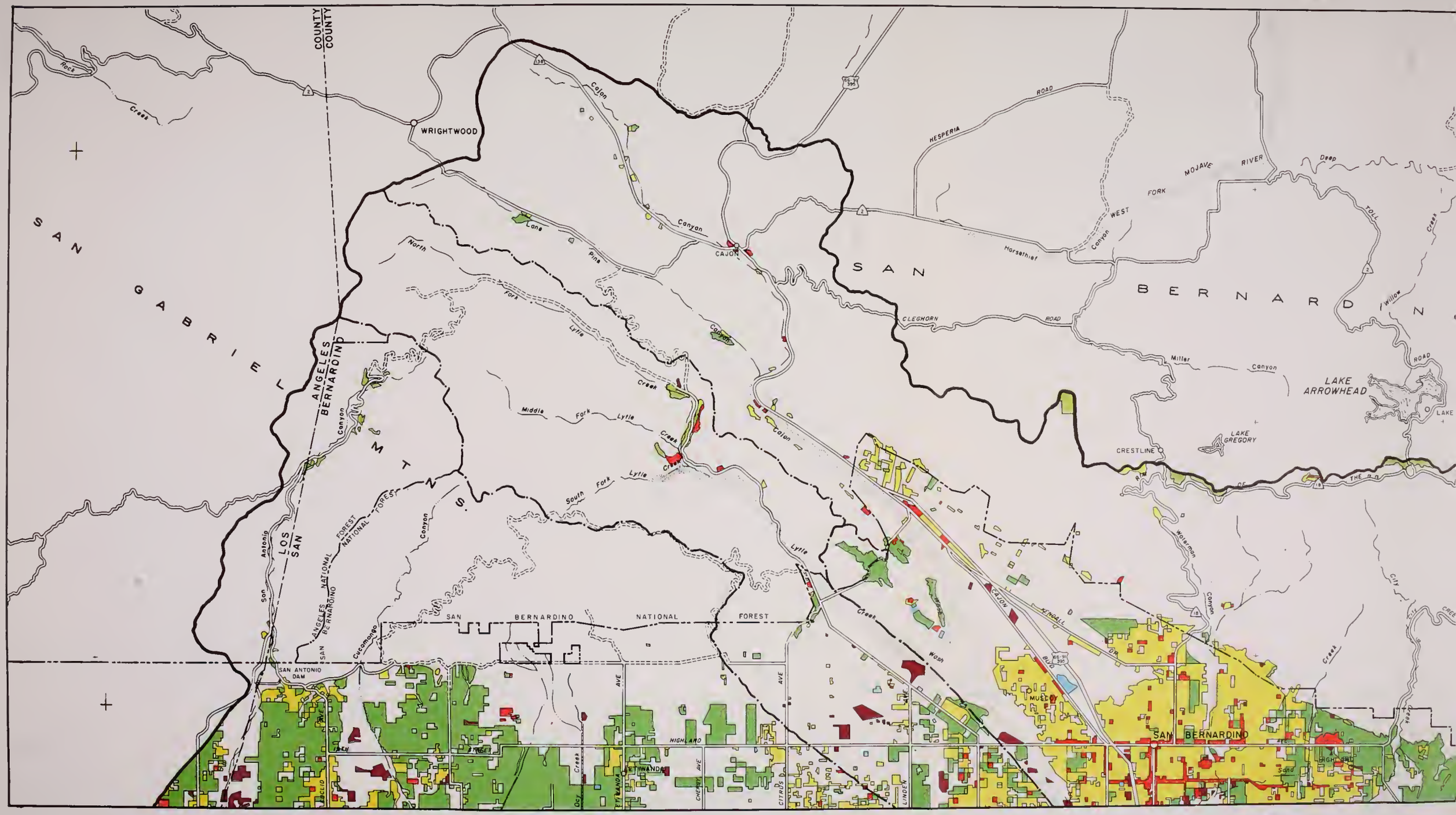
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

PRESENT LAND USE
1964

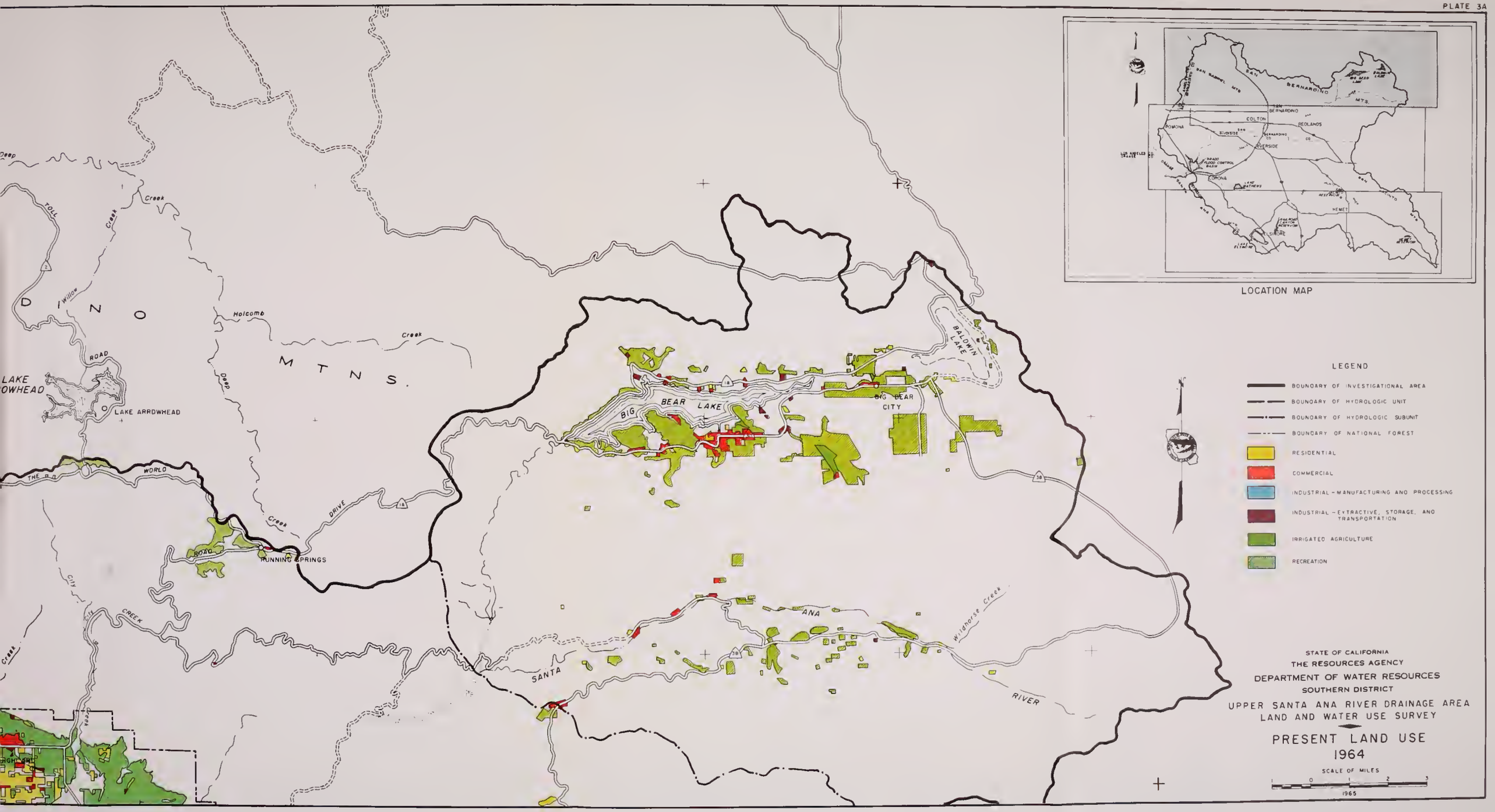
SCALE OF MILES
1 0 1 2 3

1965



SAN GABRIEL MTNS.
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
WRIGHTWOOD
CAJON
Cajon Canyon
Lane Pine Canyon
North Fork Lytle Creek
Middle Fork Lytle Creek
South Fork Lytle Creek
Lytle Creek Wash
HESPERIA ROAD
WEST FORK MOJAVE RIVER
Horsethief Canyon
CLEGHORN ROAD
Miller Canyon
LAKE ARROWHEAD
LAKE GREGORY
CRESTLINE
Waterman Canyon
SAN BERNARDINO NATIONAL FOREST
SAN ANTONIO DAM
San Antonio Canyon
Cucamonga
CAJON BLVD
KENDALL DR
MUSCOY
SAN BERNARDINO
HIGHLAND AVE
ETIWANDA AVE
CHERRY AVE
CITRUS AVE
LINDEN AVE

PLATE 3A


LOCATION MAP
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF HYDROLOGIC UNIT
BOUNDARY OF HYDROLOGIC SUBUNIT
BOUNDARY OF NATIONAL FOREST
RESIDENTIAL
COMMERCIAL
INDUSTRIAL - MANUFACTURING AND PROCESSING
INDUSTRIAL - EXTRACTIVE, STORAGE, AND TRANSPORTATION
IRRIGATED AGRICULTURE
RECREATION
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
PRESENT LAND USE
1964
SCALE OF MILES
1965
BIG BEAR LAKE
BIG BEAR CITY
BALDWIN LAKE
LAKE ARROWHEAD
RUNNING SPRINGS
SANTA ANA RIVER
Wildhorse Creek
Holcomb Creek
Deep Creek
Willow Creek
TOLL ROAD
THE WORLD DRIVE
City CREEK
D N O M T N S.
SAN BERNARDINO MTS.
SAN BERNARDINO
COLTON
REDLANDS
POMONA
RIVERSIDE
CORONA
HEMET
ELSINORE

LOCATION MAP

LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL - MANUFACTURING AND PROCESSING
- INDUSTRIAL - EXTRACTIVE, STORAGE, AND TRANSPORTATION
- IRRIGATED AGRICULTURE
- MILITARY
- RECREATION

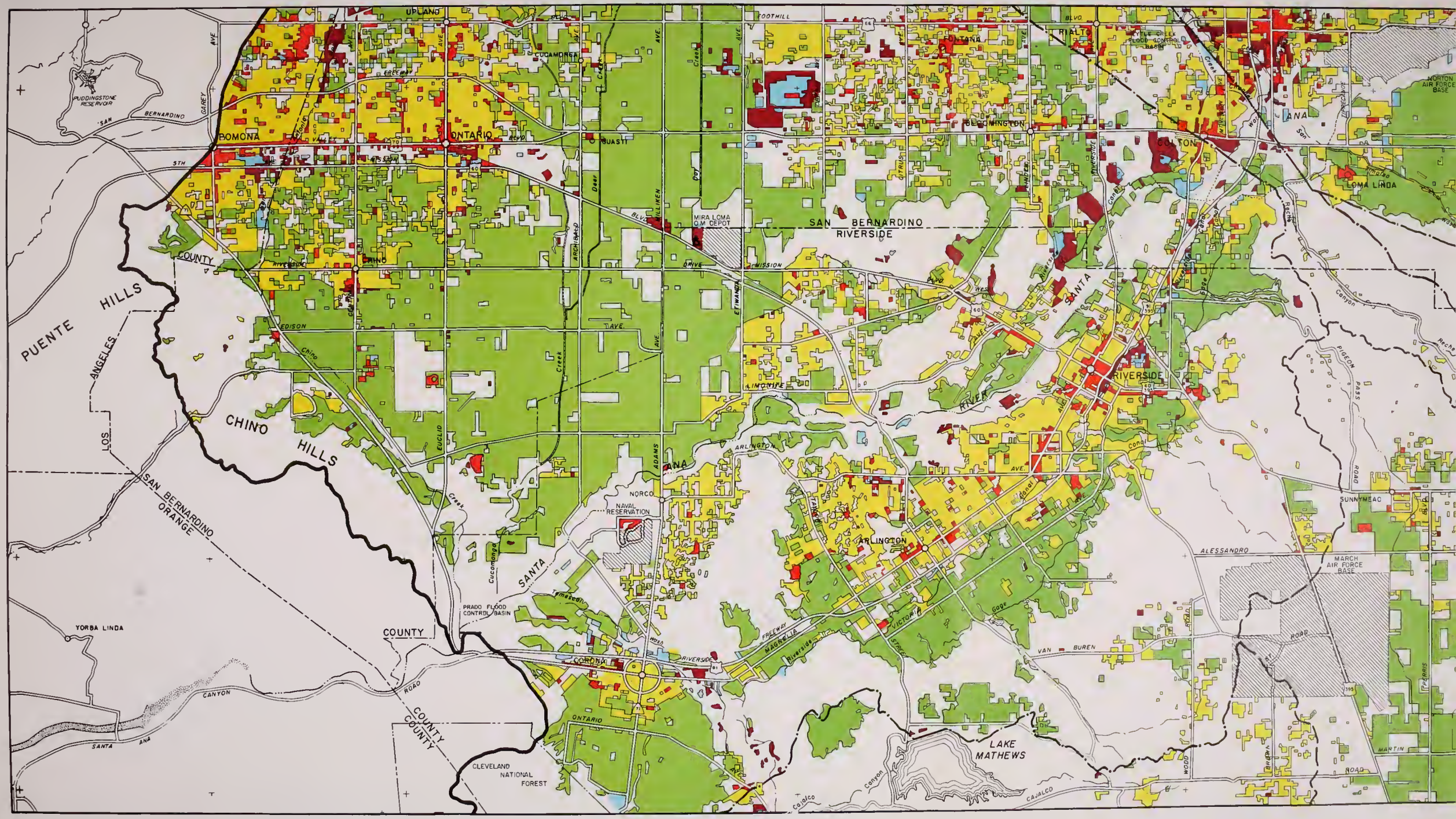
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

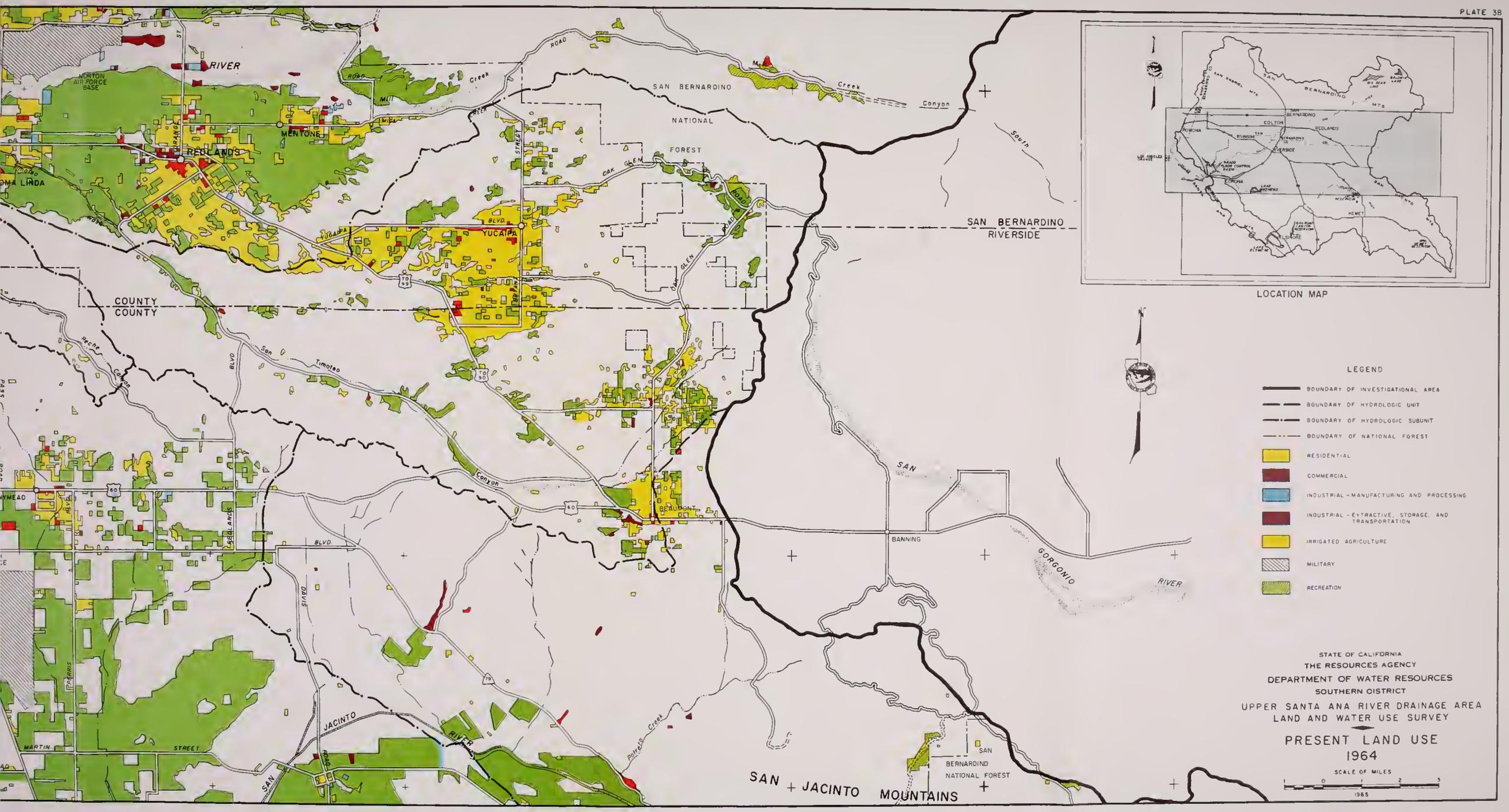
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

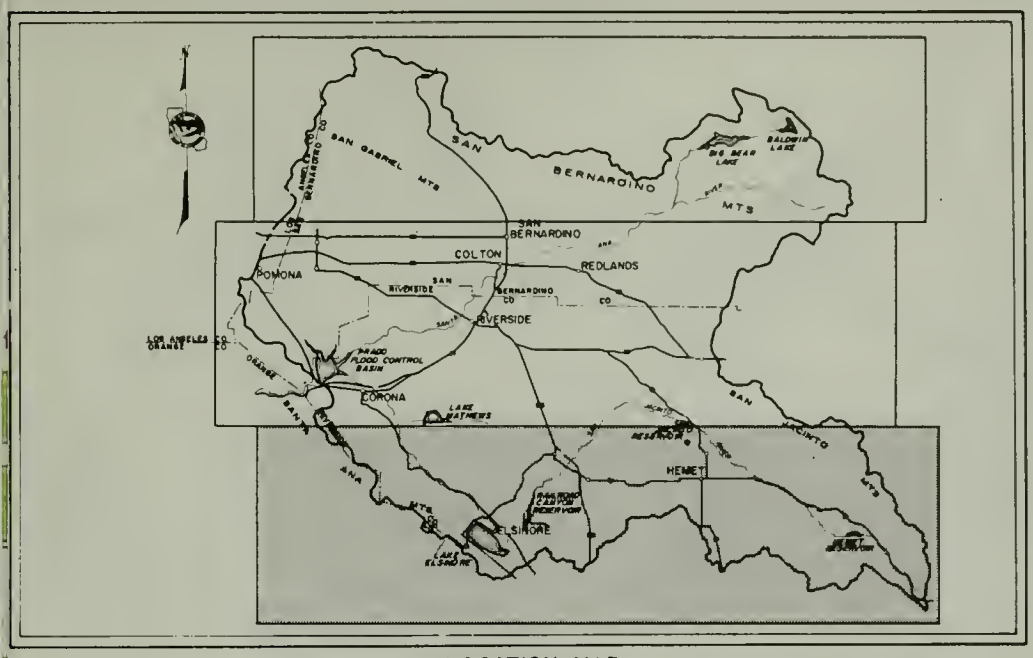
PRESENT LAND USE
1964

SCALE OF MILES
1 0 1 2 3

1965


UPLAND
CUCAMONGA
FONTANA
RIALTO
BLOOMINGTON
COLTON
LOMA LINDA
NORTON AIR FORCE BASE
PUDDINGSTONE RESERVOIR
POMONA
ONTARIO
CHINO
MIRA LOMA QM DEPOT
SAN BERNARDINO
RIVERSIDE
COUNTY
PUENTE HILLS
LOS ANGELES
CHINO HILLS
SAN BERNARDINO
ORANGE
NORCO
NAVAL RESERVATION
SANTA ANA
ARLINGTON
RIVERSIDE
SUNNYMEAD
MARCH AIR FORCE BASE
PRADO FLOOD CONTROL BASIN
YORBA LINDA
CORONA
LAKE MATHEWS
CLEVELAND NATIONAL FOREST
COUNTY
COUNTY
COUNTY


RIVER
NORTON AIR FORCE BASE
MENTONE
REDLANDS
LOMA LINDA
SAN BERNARDINO
NATIONAL
FOREST
YUCAIPA
COUNTY
COUNTY
SAN BERNARDINO
RIVERSIDE
BEAUMONT
BANNING
GORGONIO
RIVER
SAN
JACINTO
RIVER
SAN + JACINTO MOUNTAINS
SAN
BERNARDINO
NATIONAL FOREST
LOCATION MAP
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF HYDROLOGIC UNIT
BOUNDARY OF HYDROLOGIC SUBUNIT
BOUNDARY OF NATIONAL FOREST
RESIDENTIAL
COMMERCIAL
INDUSTRIAL - MANUFACTURING AND PROCESSING
INDUSTRIAL - EXTRACTIVE, STORAGE, AND TRANSPORTATION
IRRIGATED AGRICULTURE
MILITARY
RECREATION
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
PRESENT LAND USE
1964
SCALE OF MILES
1965



LOCATION MAP

LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL - MANUFACTURING AND PROCESSING
- INDUSTRIAL - EXTRACTIVE, STORAGE, AND TRANSPORTATION
- IRRIGATED AGRICULTURE
- RECREATION

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

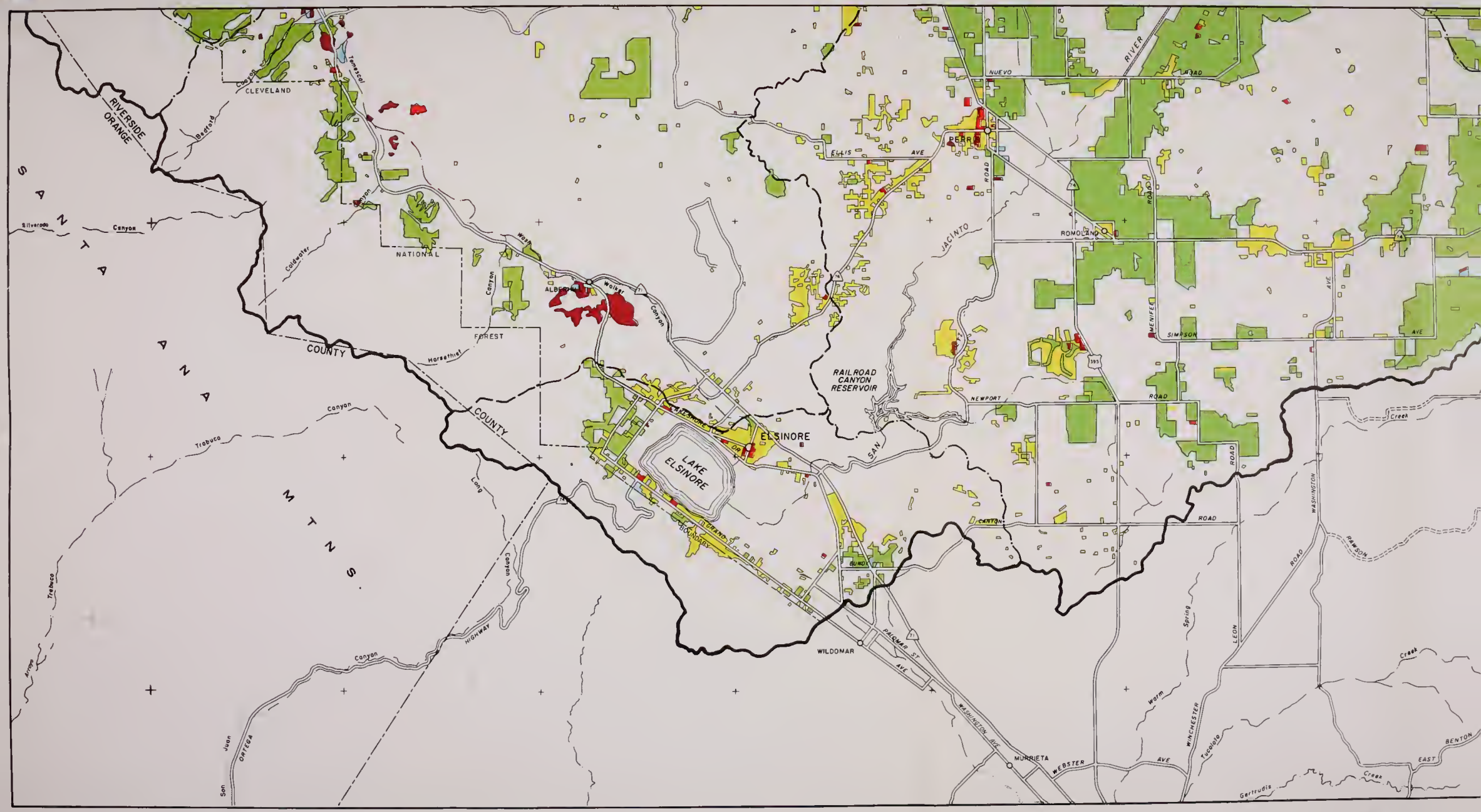
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

PRESENT LAND USE
1964

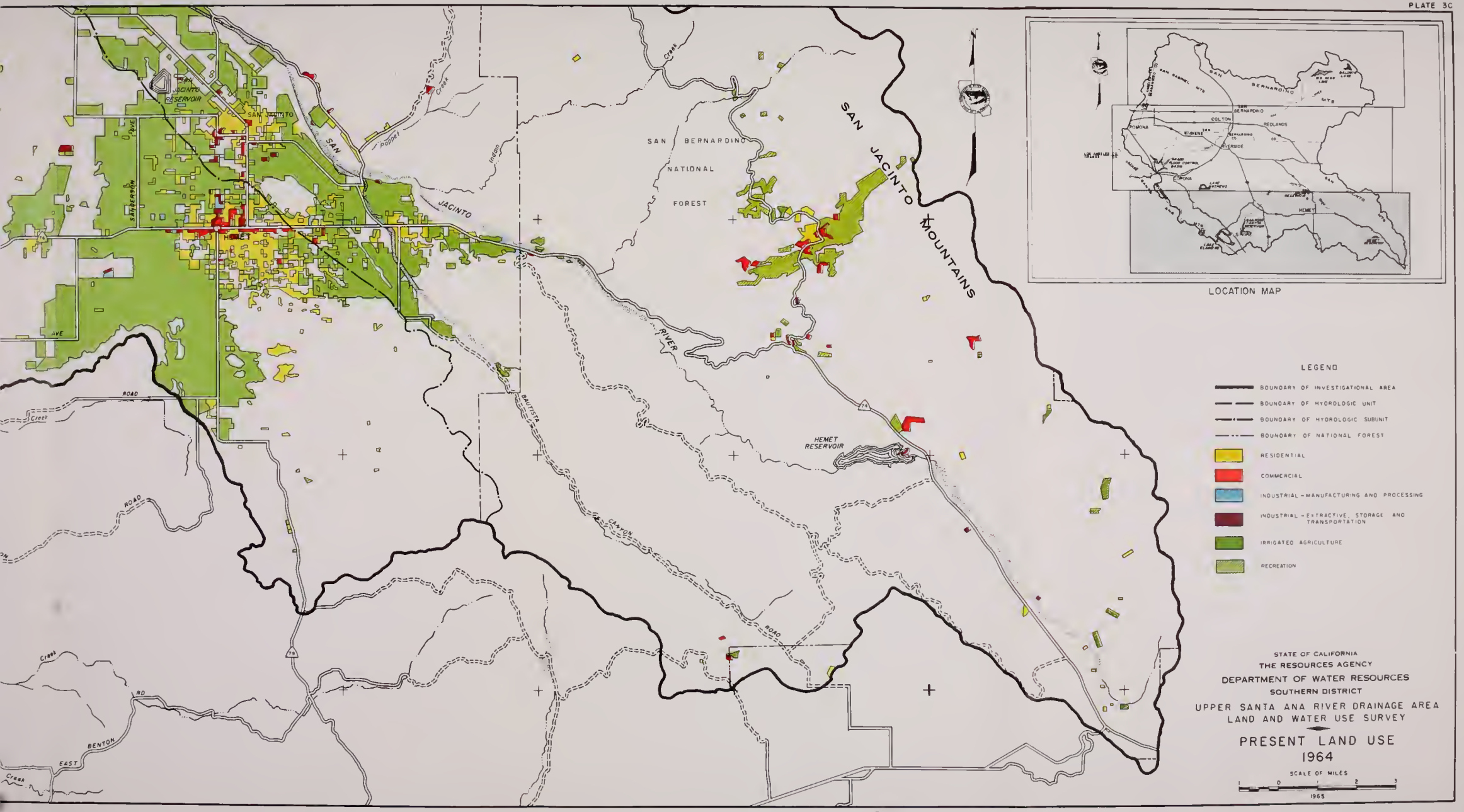
SCALE OF MILES

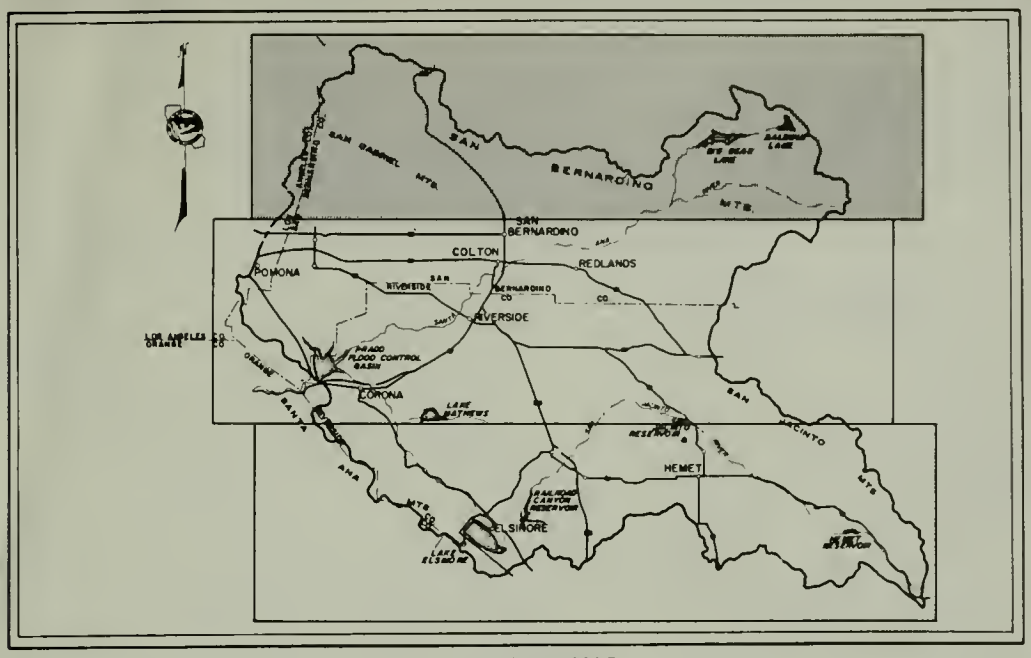
1 0 1 2 3

1965

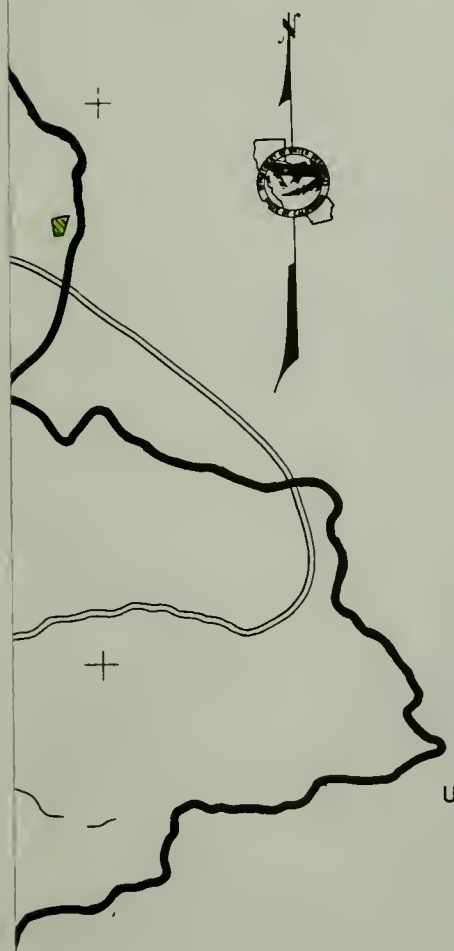


RIVERSIDE
ORANGE
SANTA ANA MTNS.
CLEVELAND
NATIONAL
FOREST
COUNTY
COUNTY
ALBERTA
Temescal
Coldwater
Horsethief
Trabuco
Canyon
Long
Canyon
Trabuco
Arroyo
Canyon
Juan
ORTEGA
HIGHWAY
Canyon
Silverado
Canyon
Bedford
Canyon
Wash
Walker
Canyon
LAKE ELSINORE
ELSINORE
LAKESHORE DR
GRAND BOUNDARY
RAILROAD CANYON RESERVOIR
SAN JACINTO
RIVER
NUEVO
ROAD
PERRIS
ELLIS
AVE
ROAD
ROMOLAND
ROAD
MENIFEE
SIMPSON
AVE
AVE
NEWPORT
ROAD
CANYON
ROAD
ROAD
WASHINGTON
RAWSON
ROAD
LEON
Spring
Warm
WINCHESTER
Tucalota
Creek
EAST
BENTON
Creek
Gertrudis
Creek
WILDOMAR
PALOMAR ST
AVE
WASHINGTON AVE
MURRIETA
WEBSTER
AVE


SAN JACINTO RESERVOIR
SAN JACINTO
HEMET
SAN JACINTO RIVER
SAN BERNARDINO NATIONAL FOREST
SAN JACINTO MOUNTAINS
HEMET RESERVOIR
BAUTISTA CANYON ROAD
SANDERSON AVE
ROAD
EAST BENTON RD
Creek
LOCATION MAP
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF HYDROLOGIC UNIT
BOUNDARY OF HYDROLOGIC SUBUNIT
BOUNDARY OF NATIONAL FOREST
RESIDENTIAL
COMMERCIAL
INDUSTRIAL - MANUFACTURING AND PROCESSING
INDUSTRIAL - EXTRACTIVE, STORAGE AND TRANSPORTATION
IRRIGATED AGRICULTURE
RECREATION
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
PRESENT LAND USE
1964
SCALE OF MILES
1 0 1 2 3
1965



LOCATION MAP



LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- URBAN EXPANSION
- RECREATIONAL EXPANSION
- IRRIGATED AGRICULTURE EXPANSION

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

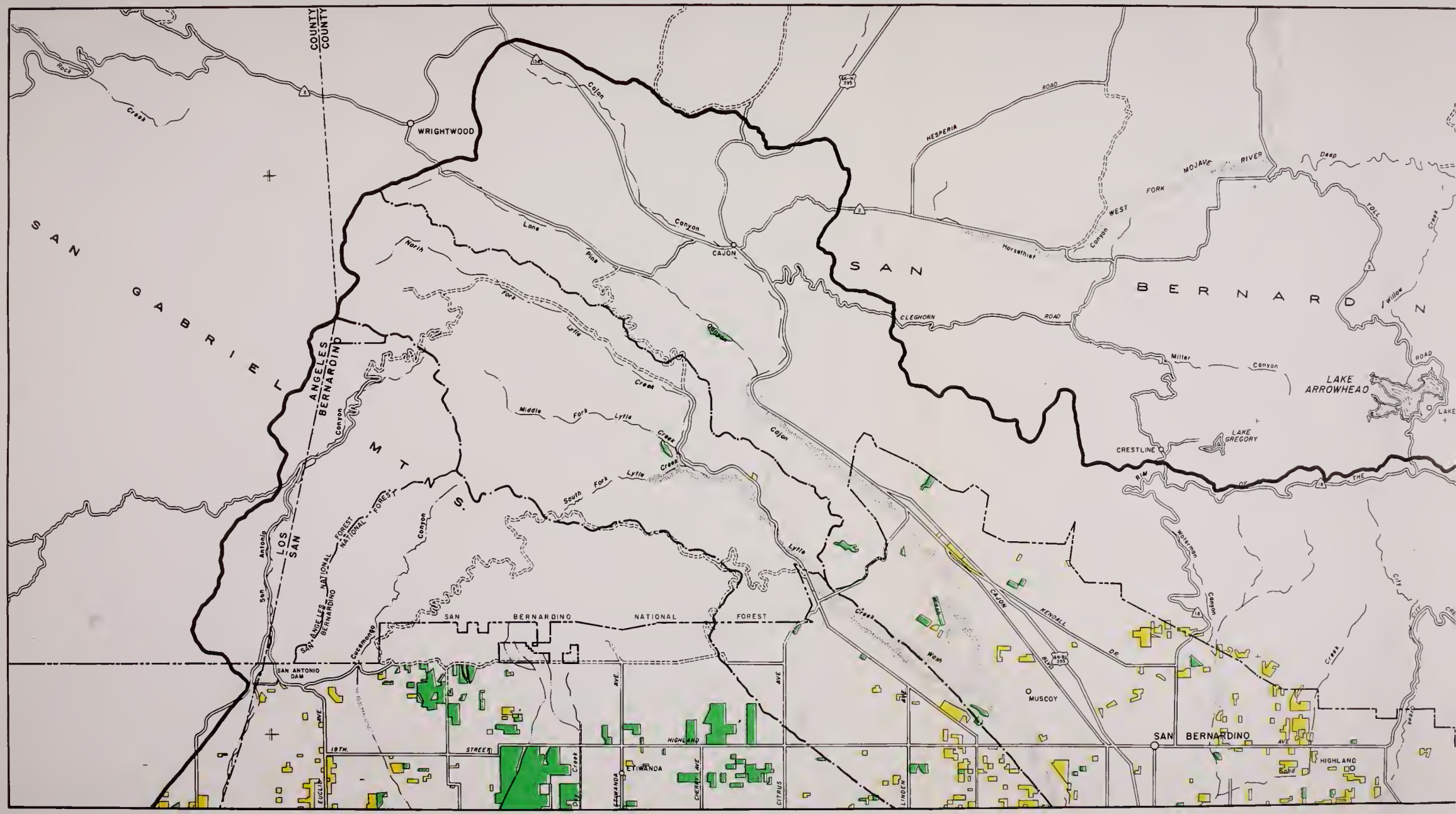
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

CHANGE IN LAND USE
1957 TO 1964

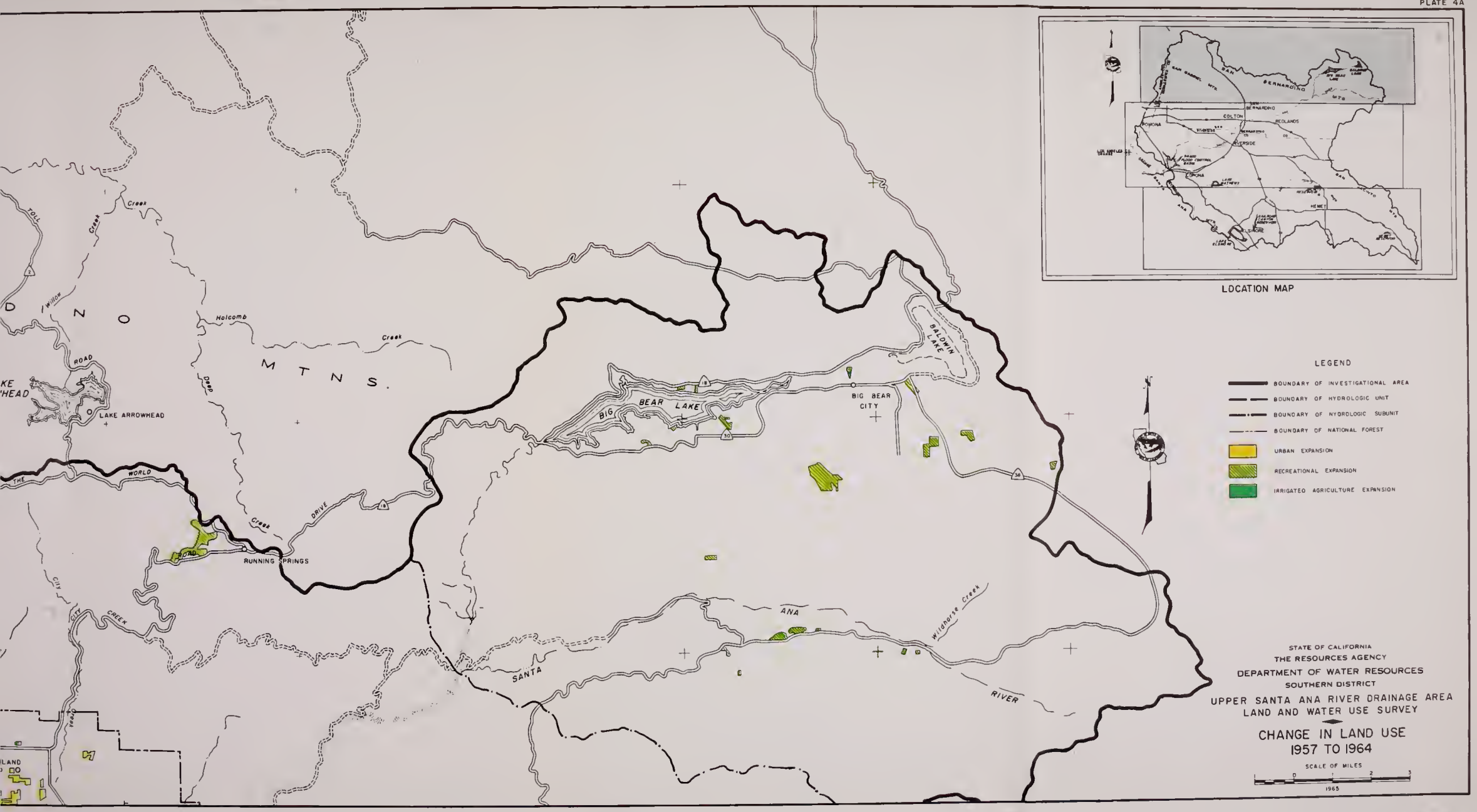
SCALE OF MILES

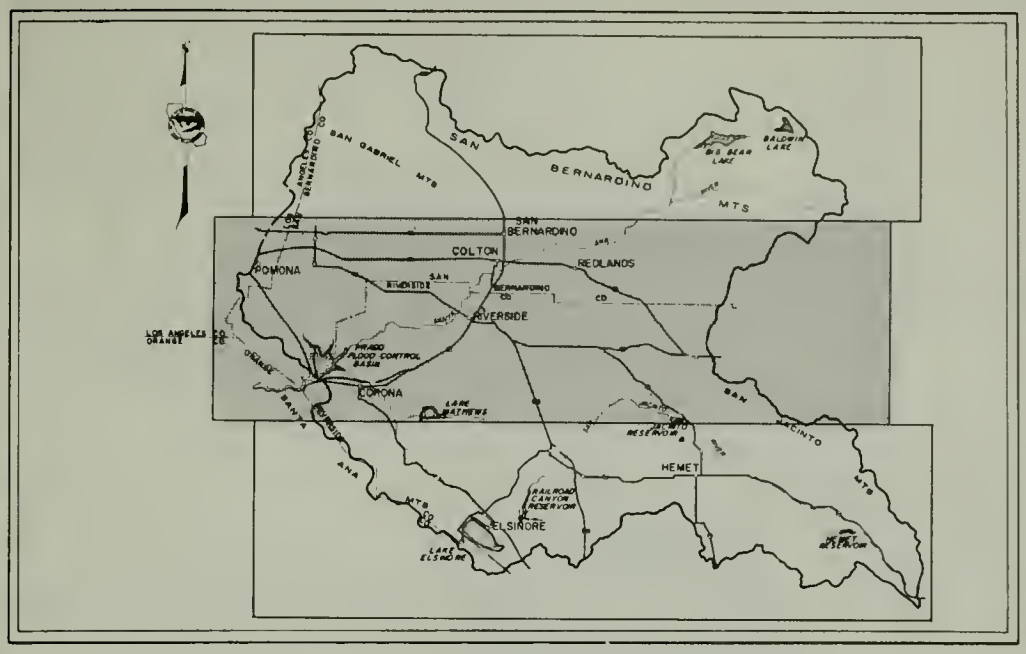
0 1 2 3

1965



SAN GABRIEL MTNS.
SAN BERNARDINO
LOS ANGELES
SAN BERNARDINO
COUNTY
COUNTY
WRIGHTWOOD
CAJON
CRESTLINE
LAKE ARROWHEAD
LAKE GREGORY
MUSCOY
SAN BERNARDINO
HIGHLAND
ETIWANDA
SAN ANTONIO DAM
SAN BERNARDINO NATIONAL FOREST
SAN ANGELES NATIONAL FOREST
SAN BERNARDINO NATIONAL FOREST
Rock Creek
Cajon Canyon
Lone Pine Canyon
North Fork Lytle Creek
Middle Fork Lytle Creek
South Fork Lytle Creek
Lytle Creek Wash
Cucamonga Canyon
San Antonio Canyon
HESPERIA ROAD
WEST FORK MOJAVE RIVER
Horsethief Canyon
CLEGHORN ROAD
Miller Canyon
RIM OF THE ROAD
Deep Creek
Willow Creek
Waterman Canyon
KENDALL DR.
CAJON BLVD.
19TH. STREET
HIGHLAND AVE.
EUCLID AVE.
ETIWANDA AVE.
CHERRY AVE.
CITRUS AVE.
LINDEN AVE.


LOCATION MAP
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF HYDROLOGIC UNIT
BOUNDARY OF HYDROLOGIC SUBUNIT
BOUNDARY OF NATIONAL FOREST
URBAN EXPANSION
RECREATIONAL EXPANSION
IRRIGATED AGRICULTURE EXPANSION
STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
CHANGE IN LAND USE
1957 TO 1964
SCALE OF MILES
1965
BIG BEAR LAKE
BIG BEAR CITY
BALDWIN LAKE
LAKE ARROWHEAD
RUNNING SPRINGS
SANTA ANA RIVER
Wildhorse Creek
Holcomb Creek
Deep Creek
Willow Creek
TOLL ROAD
THE WORLD DRIVE
CITY CREEK
SAN BERNARDINO MTS
COLTON
REDLANDS
POMONA
RIVERSIDE
CORONA
HEMET
ELSINORE



LOCATION MAP

LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- URBAN EXPANSION
- RECREATIONAL EXPANSION
- IRRIGATED AGRICULTURE EXPANSION
- MILITARY

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
SOUTHERN DISTRICT

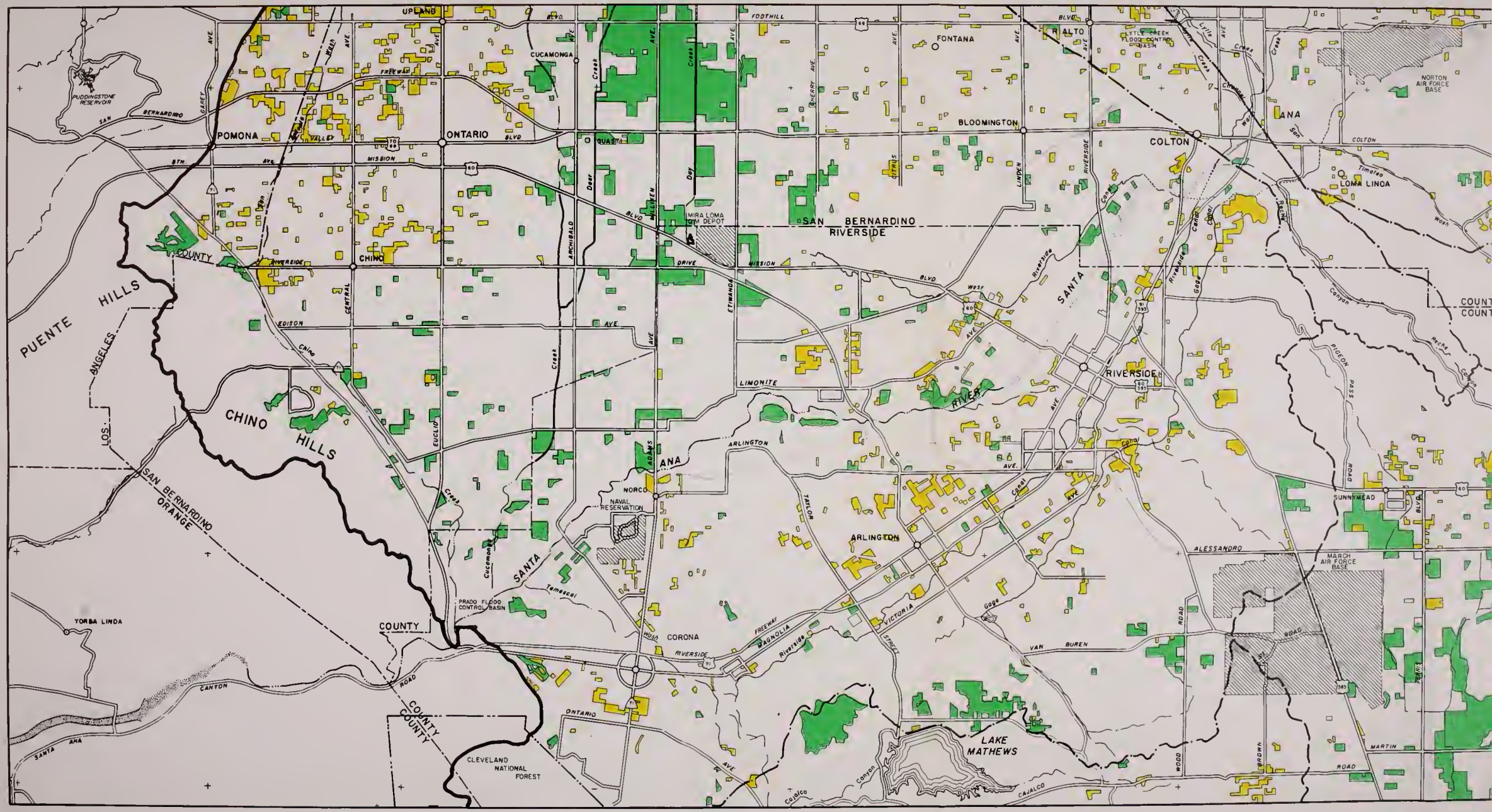
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY

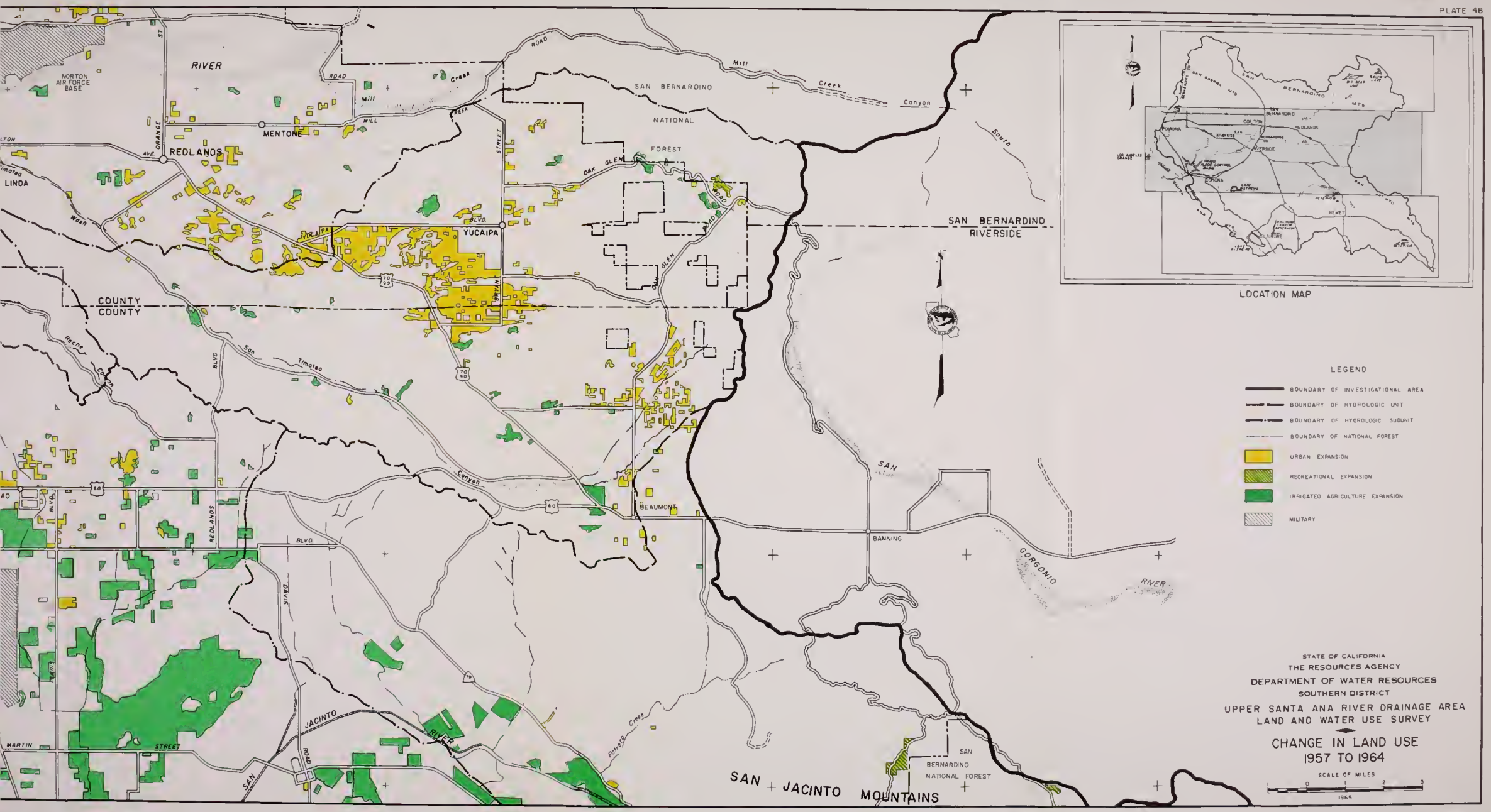
CHANGE IN LAND USE
1957 TO 1964

SCALE OF MILES

1 0 1 2 3

1965


UPLAND
CUCAMONGA
FONTANA
RIALTO
LYTLE CREEK FLOOD CONTROL BASIN
NORTON AIR FORCE BASE
PUDDINGSTONE RESERVOIR
POMONA
ONTARIO
BLOOMINGTON
COLTON
LOMA LINDA
MIRA LOMA DEPOT
SAN BERNARDINO
RIVERSIDE
CHINO
PUENTE HILLS
CHINO HILLS
LOS ANGELES
SAN BERNARDINO
ORANGE
NORCO
NAVAL RESERVATION
ARLINGTON
RIVERSIDE
SUNNYMEAD
MARCH AIR FORCE BASE
PRADO FLOOD CONTROL BASIN
YORBA LINDA
CORONA
LAKE MATHEWS
CLEVELAND NATIONAL FOREST
SANTA ANA RIVER
FOOTHILL
MISSION
EDISON
LIMONITE
ARLINGTON
ALESSANDRO
VAN BUREN
MAGNOLIA
VICTORIA
ONTARIO
CANYON
CAJALCO
MARTIN
PIGEON PASS ROAD
WOOD ROAD
BROWN ROAD
ST. FRANCIS
COUNTY
COUNTY
COUNTY
COUNTY
COUNTY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RIVERSIDE
COUNTY
COUNTY
BEAUMONT
BANNING
GORGONIO
RIVER
SAN JACINTO MOUNTAINS
SAN BERNARDINO NATIONAL FOREST
LOCATION MAP
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
BOUNDARY OF HYDROLOGIC UNIT
BOUNDARY OF HYDROLOGIC SUBUNIT
BOUNDARY OF NATIONAL FOREST
URBAN EXPANSION
RECREATIONAL EXPANSION
IRRIGATED AGRICULTURE EXPANSION
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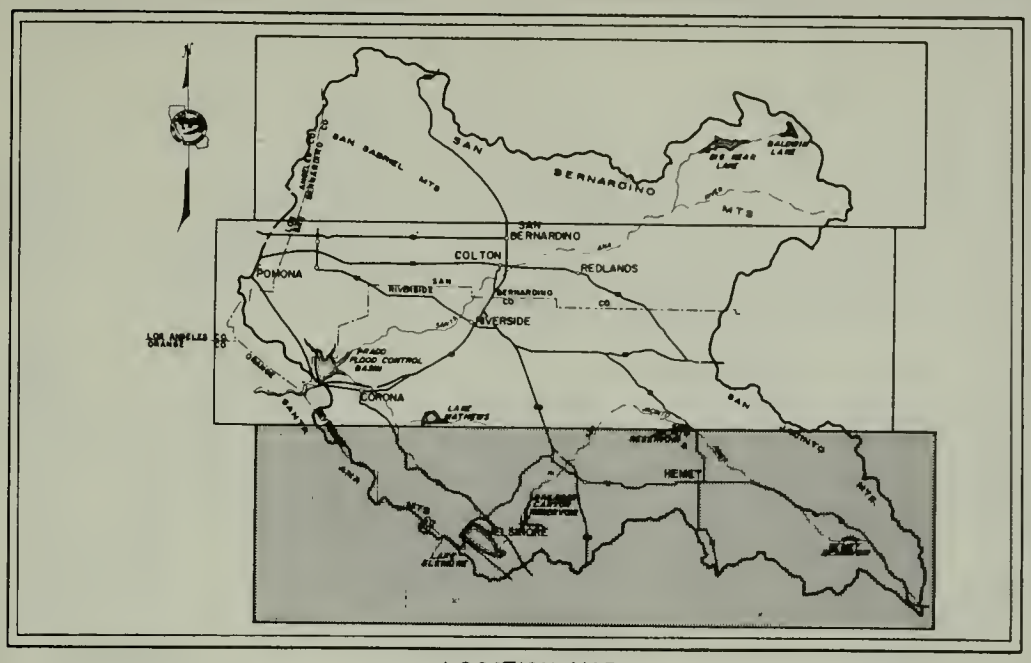
UPPER SANTA ANA RIVER DRAINAGE AREA
LAND AND WATER USE SURVEY
CHANGE IN LAND USE
1957 TO 1964
SCALE OF MILES
0 1 2 3
1965



LOCATION MAP

LEGEND

- BOUNDARY OF INVESTIGATIONAL AREA
- BOUNDARY OF HYDROLOGIC UNIT
- BOUNDARY OF HYDROLOGIC SUBUNIT
- BOUNDARY OF NATIONAL FOREST
- URBAN EXPANSION
- RECREATIONAL EXPANSION
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SOUTHERN DISTRICT

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LAND AND WATER USE SURVEY

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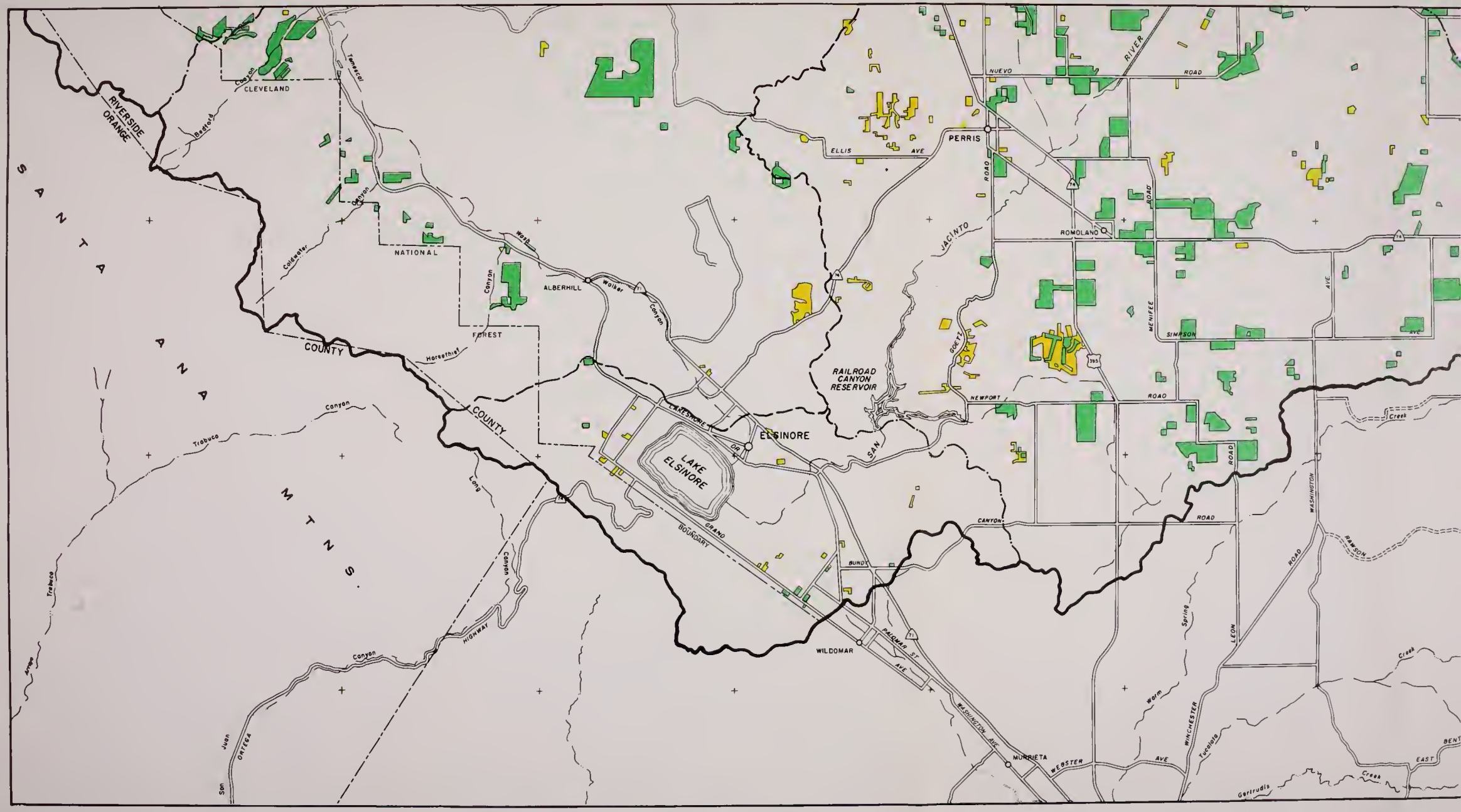
0 1 2 3

1965



SANTA ANA MTNS.
RIVERSIDE
ORANGE
COUNTY
COUNTY
CLEVELAND
NATIONAL
FOREST
ALBERHILL
PERRIS
ROMOLANO
ELSINORE
LAKE ELSINORE
RAILROAD CANYON RESERVOIR
WILDOMAR
MURRIETA
NUEVO ROAD
ELLIS AVE
JACINTO ROAD
GOETZ ROAD
MENIFEE ROAD
SIMPSON AVE
NEWPORT ROAD
CANYON ROAD
SAN JACINTO RIVER
LAKESHORE DR
GRAND BOUNDARY
BUNDY
PALOMAR ST
WASHINGTON AVE
WEBSTER AVE
WINCHESTER ROAD
LEON ROAD
WASHINGTON ROAD
RAWSON
Temescal
Bedford
Canyon
Coldwater
Horsethief
Wash
Walker
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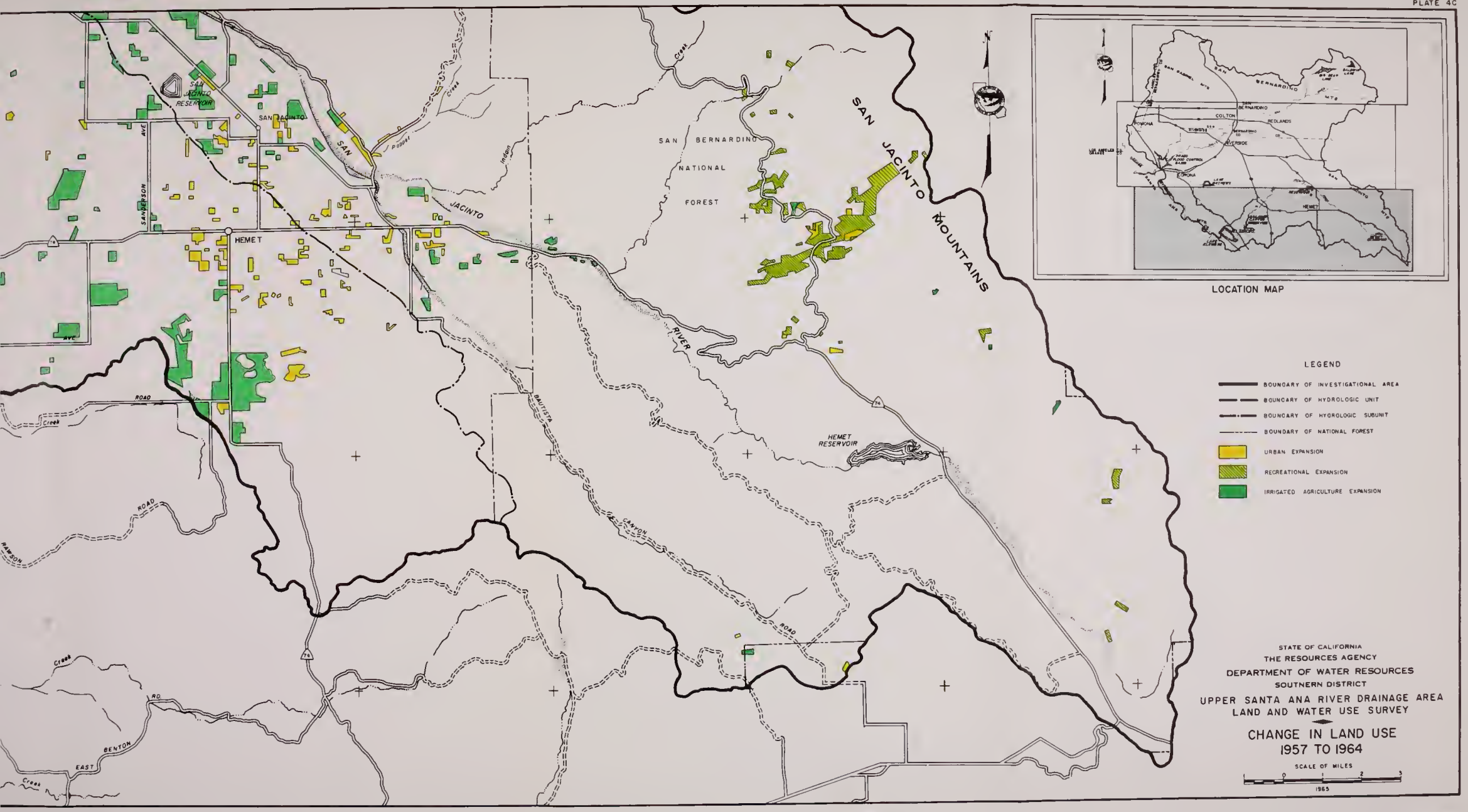
Long
Canyon
HIGHWAY
ORTEGA
San Juan
Warm Spring
Tucalota
Gertrudis
Creek
EAST


SAN JACINTO RESERVOIR
SAN JACINTO
HEMET
SAN JACINTO RIVER
SAN BERNARDINO NATIONAL FOREST
SAN JACINTO MOUNTAINS
HEMET RESERVOIR
SANDERSON AVE
ROAD
BAUTISTA CANYON ROAD
RAWSON ROAD
BENTON RD.
EAST
Creek
LOCATION MAP
SAN BERNARDINO
COLTON
REDLANDS
RIVERSIDE
POMONA
CORONA
HEMET
LEGEND
BOUNDARY OF INVESTIGATIONAL AREA
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